THE

# FOUNDRY TRADE JOURNAL

*WITH WHICH IS INCORPORATED*

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**THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.**

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**Secretary, E. J. Griffiths, 20, Fisher Street, Swansea.**

## Forthcoming Events.

DECEMBER 14.

*Swansea Technical College Metallurgical Society*:—Ordinary meeting at Swansea. "The Driving of Sheet and Tinplate Mills," Paper by J. Selwyn Caswell, M.Sc.

**Institute of British Foundrymen.**

DECEMBER 14.

*East Midlands Branch*:—Ordinary meeting at Nottingham. "The Production of Castings for Internal Combustion Engines," Paper by A. L. Key.

*Wales and Monmouth Branch*:—Ordinary meeting at Newport. "Steel Making," Paper by Prof. Edwards.

DECEMBER 21.

*Lancashire Branch (Junior Section)*:—Meeting at Manchester. Short Paper night.

## The Industrial View of Education.

We referred recently to the Government proposal to raise the school-leaving age, and it is worth considering in this connection what is or should be the attitude of industrial men to education as distinct from trade training. It will be agreed that the last word on education has not yet been said in this country, but what the next word should be is still matter for discussion. There are some who would favour nothing more elaborate or revolutionary than a wholesale raising of the school-leaving age, the schools to remain exactly as they are at present. There are others who would like to see an extension of the scholarship system, since it is well known that at present only a small proportion of the children who qualify for secondary education are able to obtain it. There are still others who want part-time education, in the form of a couple of half-days a week or thereabouts for all employees between the ages of 14 and 16, subsequently 14 to 18. From the point of view of the employer, what is there is to be said on each of these counts? In the first case, the raising of the school age would merely mean that the boys would enter industry one year older and consequently one year less adaptable than they are now, and no better prepared for industrial conditions than at present. In the second case, since the great bulk of scholarship children find their way into the black-coated occupations, the result of an extension of the system would be to drain industry of the better part of its material—although it must be remembered that the growth of the staff grades means that industry itself requires an ever increasing number of these same black-coated workers. In the third case, provided the initial difficulties of organisation are overcome, part-time education might well solve many problems by establishing a real contact between industry and education such as, unfortunately, does not at present exist. From the industrial point of view, however, the real essential is that there should be closer contact between education and industry, and that the educational system should be—if the expression be permitted—less scholastically-minded, in view of the large proportion of children who do find their way into industrial employment. This might be assisted by each and all of the three methods referred to. A higher school-leaving age would be valuable if the further education provided were adapted to meet industrial needs. Further training for the better children would be available if there were opportunities to obtain it in industrial as well as in purely scholastic directions. Part-time education would be best of all if it were of a kind to appeal to the juveniles already employed in industry and if it would be of real use to them. Broadly speaking, it may be agreed that it would be better for the children of the nation to stay at school beyond fourteen years, provided that the study offered be on broader lines than at present, and that it would also be desirable to provide part-time education for juveniles during their first years in industry, whatever the school-leaving age, in order that the present gap between work and school may be bridged.

## Time Wasting and Efficiency.

Mr. Gardom made a remark from the chair, when presiding over the annual dinner of the London Section of the Institute of British Foundrymen, to the effect that the efficiency of a manager could be gauged by aggregating the amount of time taken to make decisions in any given period. We think this platitude might be extended to cover also the efficiency of firms. There exists in Great Britain a type of foundry which apparently is always on the verge of being extended or rebuilt on a nearby site. There is even no definite decision as to this. Such foundries insist on practically every representative calling upon them, drawing up a complete scheme based upon a negligible amount of data. Each supplying firm does its best, whilst obviously incorporating its own specialities. Altogether, a few hundreds of pounds are expended in the various drawing offices of the foundry equipment engineers, and finally, when the scheme does mature, it usually happens that the foundry executive is temporarily turned into constructional engineers, generally to the detriment of healthy production. Whilst we deplore the excessive cost this entails, we ascribe the whole of the ills it produces to lack of decision on the part of the management.

If a foundry intends extending or rebuilding, the executive should make up its mind initially whether it will carry the job through itself or whether they will employ a consultant or a specialist firm to do it for them.

Of the two alternatives, the employment of a specialist is the better for the smaller concerns, whilst the creation of a temporary foundry construction department is preferable for the largest organisations. The latter assumes that the existing foundry can be run efficiently, with the manager acting merely as its consultant, because the creation of a new establishment will demand the whole of his time.

In any new construction or extension work, if there is ever any question as to the advisability of creating home-made foundry plant, we strongly advise it to be turned down as bad business on the grounds of ultimate cost. It is as well to keep in mind that the best equipped general engineering establishment could not make a model of the cheapest make of motor car under £2,000, and even then the result would be no better than the mass produced article. This at least should represent a question on which no time should be wasted in making a decision.

XUM

# Foundry Purchasing—XXXVI.

By Eric N. Simons.

### Need for Invoice Checking.

No suggestion is made that these errors in suppliers' invoices are intentional: the probability is that they are entirely accidental; but this does not alter the fact that they have to be guarded against, and the only department that can efficiently do this is the buying department. The accountant is dealing with many other tasks besides the examination and payment of invoices and statements, and it is unreasonable to expect him to take upon himself the supervision of what is essentially a buying department duty. His work is to pay the invoices and record the sums paid, not to decide what invoices shall and shall not be settled. It is true that the accounting department should draw the attention of the buyer to any seeming oversight it detects, and ask for an assurance that all is in order before settling a doubtful invoice; but the point is that the buying department should not regard the accounting department as its safeguard against error. The boot should be on the other leg.

### Invoice Registers.

In the United States, certain firms keep what is known as an invoice register, in which the dates and details of all incoming invoices are noted down, constituting a permanent record. This work is done by the buying department, and the arguments put forward for it are: that as invoices have often to be submitted to directors, departmental managers, and so forth, before they can be passed for payment, there is always a possibility of their getting lost, the result being a delay in settlement, and possibly the loss of cash discounts or similar terms; that anything tending to delay the payment of invoices weakens the confidence of suppliers in the buyer, and deprives him of an asset in bargaining, *i.e.*, the promptness with which his firm meets its invoices. This deprivation prevents him from getting, as he normally would get, the best economic advantages from the various markets in which he buys, since suppliers will always make their best offers to the firms known to be ready in settlements. By keeping a day-to-day register of all invoices, the whereabouts of each one can be perceived, and delays prevented, and the possibility of duplicate invoices getting through for payment is minimised. In spite of these plausible arguments, the writer is definitely opposed to this scheme. It seems to him to involve a needless amount of work, which could be obviated without any loss of efficiency.

But since the practice exists, and all buyers may not agree with the writer's view, it will be as well to outline the method briefly before going on to suggest a simple alternative.

As soon as invoices are received, they are passed forward to the buying department, and recorded in a loose-leaf book or ledger, similar in character to that shown in Fig. 1. These ledger sheets register the name of the supplier, the date of the invoice, the material concerned, and the total amount. There are spaces then provided for record details, *e.g.*, date of receipt, date sent to a department or official, date returned, date sent in to accounting department for payment, amount of cash discount (if any), and date of expiry of discount or other offer. The loose sheets, when completed, are filed in a special box for reference. Any occurrence of a duplicate invoice is at once detected, and reported by the recording clerk to the buyer.

### A Simpler and Better Method.

This, as the writer has said, is in his opinion a clumsy and tedious method of procedure, involving a good deal of clerical work. A much simpler method is to use the order record card as invoice record card as well, as shown in a previous article. The insertion of the invoice value figures is only made when the invoice has been received. Any duplicate invoice is at once detected. This is as much recording as is essential at this stage. Where the necessity for sending invoices to different officials and departments outside the buying office exists on anything like a large scale, the difficulty can be overcome by instructing the supplier to send duplicate invoices. The buyer retains the original, and sends the duplicate for checking and passing purposes to the manager or department concerned, and does not pass forward the original for payment until the approved duplicate is returned to him. All invoices awaiting approval are retained by him in a file or clip on his desk, or that of his clerk, and he makes a practice of going through these each day. For convenience a rubber stamp impression is set on each invoice (see Fig. 2) to show when discount claims expire. Two minutes will enable him to pick out the more urgent invoices, and he can then make the necessary inquiries to find out why their approval has been delayed. The department to which the duplicate invoice has been sent is sufficiently indicated by the use of symbols are letters in the order number, and the elaborate recording indicated in Fig. 1 is unnecessary.

INVOICE RECORD. SHEET NO. .....

| Supplier. | Material. | Date of Invoice. | Amount. £ s. d. | Cash Disct. | Disct. expires. | Recd. | Sent to | Retd. | Sent to Cashier. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

Fig. 1.—Typical Invoice Register Sheet.

CASH DISCOUNT
EXPIRES .....

Fig. 2.—Rubber Stamp for Invoices.

### Another Invoice-Checking Plan.

Another method adopted by various business houses is for the invoices to go first to the accounting department, where they are checked against "Goods Received Notes" from the stores and weigh offices, the invoices finally going to the buying department for price confirmation only. This, again, seems to the writer a wrong procedure. The man who buys the material is surely the man who should examine the invoices for that material, to ensure that all the economic advantages for which he has striven are perceptible and included. At the very least, he should have the checking of prices and quantiites, even if, for internal reasons, he is not allowed to check quality. In this matter of invoice procedure, a great deal depends on the organisation of the firm concerned. Wherever stores accounts are subject to examination and control by the buying department, and the storekeeper is himself subordinate to the buyer, it is probably better for all invoices to be dealt with by the buying office until they reach the stage at which payment is recommended, when they may be turned over to the accounting department. In very large firms, where the book-keeping of stores and production departments is extremely complicated, and is apart altogether from the buying department's operations, the storekeeper being really an independent stores manager, the procedure may have to be considerably modified, as in the instance specified above, where the buyer merely checks prices and quantities, everything else being entrusted to the accounting department. Each firm must adapt its system of invoice handling to its own needs.

### Standard Procedure.

Briefly, the standard procedure is for the invoice, when received, to be recorded, either briefly or elaborately, according to which of the two methods outlined is adopted. Duplicate or doubtful invoices are withheld from circulation, and passed back for investigation. Those that seem in order are then rubber-stamped with the date on which cash discounts expire, and the date is filled in, preferably in red ink to ensure greater visibility.

The next step is to secure the approval of the invoice. Either the original, or, as suggested, a duplicate, is sent to the department for which the goods were ordered (where only this department can satisfactorily pass the details). The manager or official responsible affixes his signature or initials, the symbol or name of the account to which the goods are to be charged, and the date. The invoice then returns to the buying department. If the goods are such as do not concern particular departments, but consist of standard supplies, ordered by the buying office for general consumption or stock, the work of passing the invoice is done in the buying department itself. Details are usually checked in the following order: quantity, quality, price, extensions, totals, terms of delivery, terms of payment. The initials of the checker should invariably be attached to every invoice passed, so that

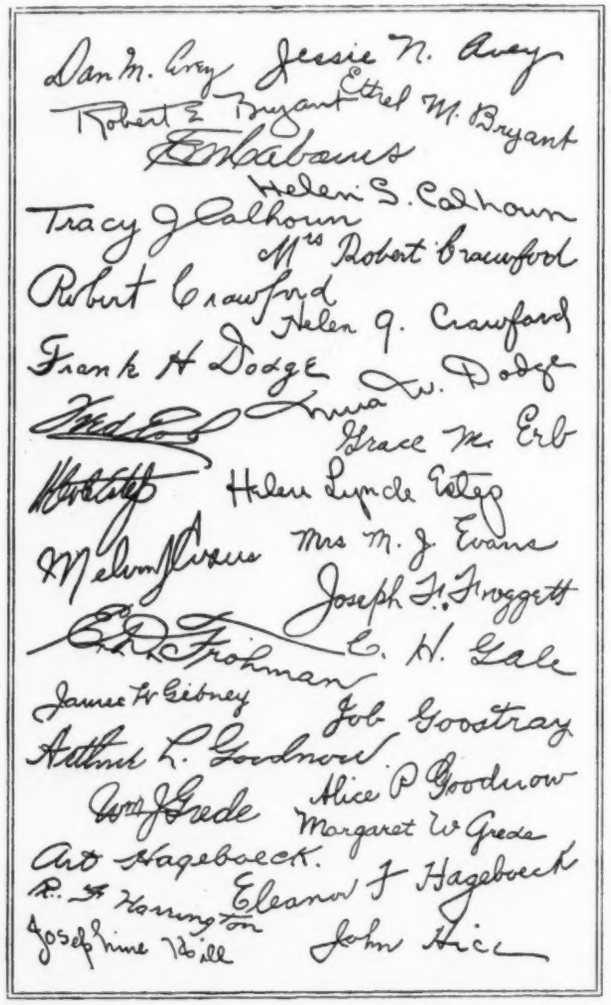
(*Continued on page* 420.)

INVOICE CERTIFIED CORRECT.

| Material. | Quality. | Quantity. | Price. | Extens. |
|---|---|---|---|---|
| | | | | |

*Checker to initial under appropriate headings.*

Fig. 3.—Certificate for Correct Invoice.



# To:

**The Institute of British Foundrymen**

**The Foundry Trades Equipment and Supplies Association, Ltd.**

**The Officers and Directors of These Associations**

**The Local Branches Throughout England and Scotland**

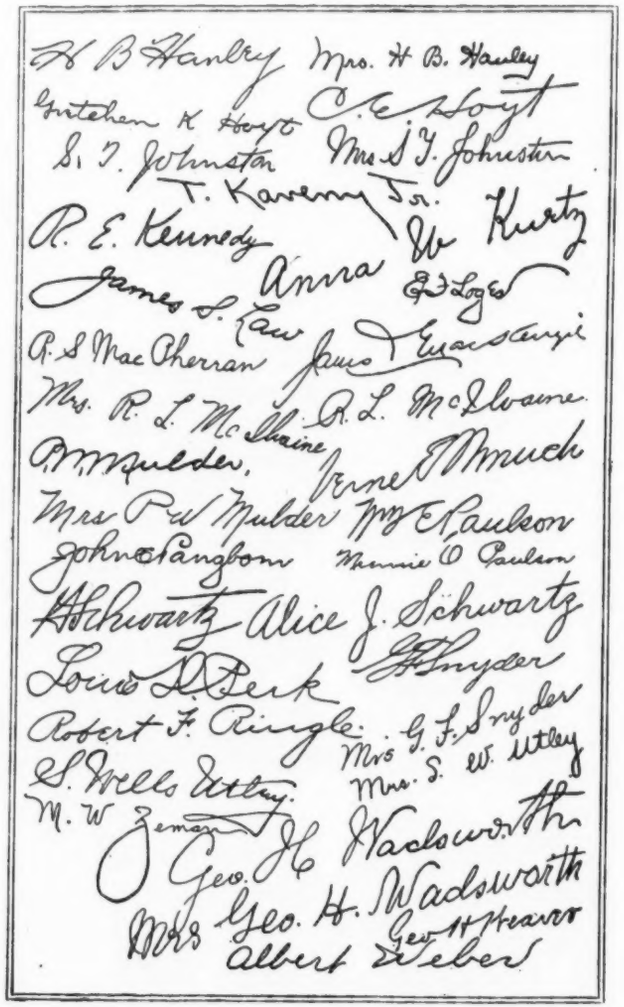
**Members and Friends—**

# Greetings:

We, the members of the American Foundrymen's Association Delegation to the Third International Foundrymen's Congress representing the foundry industry in America, hereby individually express and collectively record our deep appreciation for your kindness, hospitality, courtly courtesy, and entertainment.

For many, last summer's visit to your land represented the renewal of former pleasant contacts. For others, this was first acquaintance. All of us now are united in a bond of pleasant recollections sustained by the hope and anticipated pleasure of retaining your friendship through the years to come.

*Done at Chicago, Illinois, September, 1929.*



*This pleasing Souvenir has been sent by the American Foundrymen's Association to the Associations and Members of the British Foundry Industry in an endeavour to stress the appreciation of the Individual participants in the International Congress.*

## Advertising the Foundry Industry.

A rather unusual subject was presented for discussion to the last meeting of the South Staffordshire Iron and Steel Institute by Mr. Reginald Wilson, who dealt with "What Advertising can do for the Iron and Steel Industries." After insisting that amelioration was an internal and not a political question, the lecturer cited the case of Mr. J. H. Thomas' origination of an inquiry for a large consignment of British steel for Canada, by stressing British ability to give service.

The first proposal put forward was the replacement of wooden sleepers by fabricated steel; a second pointer was that, having in general established the excellent quality of British ferrous material, selling (if price considerations were reasonable) was an easy proposition for the expert. Advertising, Mr. Wilson defined as "the driving force in the commercial machine, turning the wheels of industry, maintaining sales that are good and making them better, stimulating lagging markets and creating new ones." This force, according to the author, was being dissipated because the advertisers fail, in most cases, to make adequate use of the space they buy. They must either learn the science of advertising or employ one thoroughly versed in the subject.

Stressing market research as a prerequisite before any campaign, then the selling points are developed and the art of the copy-writers, lay-out men and artists is brought in to create a stimulating message.

After discussing the potentialities of co-operative advertising as applied to iron and steel, the author, utilising statistics prepared by The Foundry Trade Journal, outlined the existing economic position of the iron and steel trades and the current trend of affairs, and in this connection he deplored the modern fetish for standardisation. This he asserted was an acknowledgment of a lull in progress, and it often retarded the progress of those firms having material for sale superior to the standard specification. Finally, Mr. Wilson inclined to the view that pig-iron was a suitable material for advertising, owing to the large number of potential users.

## Foundry Purchasing.—XXXVI.

(*Continued from page* 418.)

in case of error the blame can be attributed to the proper person.

Some firms go to the trouble of preparing and affixing to each invoice elaborate forms for the "approval" of invoices, similar to and sometimes much more detailed than that shown in Fig. 3. These, to the writer's way of thinking, constitute system run mad, the extravagancies of fear rather than the careful safeguards of a well-balanced mind. There is also the obvious drawback that a form of this sort could be pulled off one invoice and stuck on to another without difficulty. If it is necessary—and the ridiculously small dimensions of some invoice forms demand it—to provide a special space for the signatures of the checkers, a rubber stamp is all that is necessary, on the lines of Fig. 4, and the

CHECKED AND FOUND CORRECT.

P E Q

Fig. 4.—Rubber Stamp for Invoice Checkers.

details can be filled in in red ink. (P = price, E = extensions, and Q = quantity.) This will stand out even when the invoice is congested with writing and "white space is scarce."

A Central Commercial Committee for the Polish iron foundry industry has been established at Warsaw. This will act as a co-operative sales organisation. Eight new members commenced participation on October 1, and it now controls 98 per cent. of the total output of the industry.

## I.B.F. Branch Presidents—No. 3.

### NEWCASTLE BRANCH.

Mr. R. H. Smith first made contact with the foundry industry by serving a seven-years' apprenticeship at Messrs. Sir Charles A. Parsons & Company, Limited, of Wallsend. He commenced his training in the drawing-office and then passed into the shops. He was able thereby to obtain a fairly extensive experience of turbine engines. In 1912 he left the firm in order to assist his father, who was in business as an iron-

Mr. R. H. Smith.

founder. At the present time, Mr. Smith is managing director of the firm which, on reorganisation in 1923, became Messrs. Smith & Company (South Shields), Limited. This concern manufactures marine engine castings weighing up to 20 and 25 tons.

Mr. Smith became a member of the Institute in 1913, and holds the McLain diploma for cupola practice and semi-steel.

## Manchester Association of Engineers.

The quarterly meeting of the above Association will be held at the Engineers' Club, 17, Albert Square, Manchester, to-morrow evening at 7.15.

Members of the Institution of Mechanical Engineers (North-Western Branch) have been invited to be present at this meeting as the guests of the Association, and a Paper on "Electric Furnaces for Steel Melting" will be presented by N. Ryland Davis, M.A., and C. R. Burch, B.A. The Paper will be published in our issue of December 19.

## Consolidation of Italian Steel Trade.

After long and laborious negotiations, carried on under Government auspices, the Italian metal-trade associations have just formed a Consortium embracing practically the whole of the Italian steel trade. Its first act has been to form a joint stock company for the sale of iron and steel sheets and bars, to be followed by others for the sale of steel rods, etc.

## Random Shots.

I believe that when the three Midland metallurgical institutions first formed their Co-Ordinating Committee they were in hopes that the move would be followed in other parts of the country—perhaps they were exercised about that same problem of "Associations" to which space has been devoted recently elsewhere in this journal. A friend who lives in that part of the world has just written me an account of their annual dinner, which took place in Birmingham recently, and he says that one of the speakers on that occasion admitted that nothing of the sort had yet happened. One of the participating bodies is, of course, the historic Staffordshire Iron and Steel Institute, but in spite of this I gather that the occasion was mainly non-ferrous in character; perhaps because the institution mentioned has its own annual dinner rather nearer home, so to speak.

* * *

My informant tells me that following a recent fashion the affair was a dinner-and-dance instead of the more formal dinner. The speeches were strictly limited in number and in length—surely by no means entirely a disadvantage!—and the dancing that followed was extremely popular. It is a point worthy of notice that the marked decline in the craze for public dancing should be accompanied by a marked increase in the taste for private or semi-private dancing. I believe the dance-halls are being transformed into skating rinks. Will the time come when our banquets will be followed by ice-skating?

* * *

Talking of dinners, an occasion of a somewhat different character was the annual dinner of the I.B.F. London branch, which took place on December 6. These branch dinners—and the London branch dinner in particular—have something of a reputation among those of us who know how to enjoy a good time. Annual conventions and such-like have their own special charms, but if you want a real family affair, try the London dinner! (Even if the past-Presidents don't all wear their little medals!)

* * *

The principal guest was Professor Sir Harold Carpenter. His presence was peculiarly fitting because of an early connection with the new London branch president, Mr. J. W. Gardom, who formed part of the original nucleus of a Department of Metallurgy in the University of Manchester—whose professor was, of course, this same Sir Harold. His speech, too, was extraordinarily clever, and his account of a conversation with the manager of a Nevada silver-mine afforded a striking example of the apt retort!

* * *

Another distinguished speaker, Sir William Larke, of the National Federation of Iron and Steel Manufacturers, contributed to the wit of the evening by his definition of an optimist as a flea trying to bite Mr. Keating! Another gem might be cited as an alternative—namely, the Scotsman who sent a pair of spats to be soled and heeled!

* * *

This week's example of the Brighter Foundries Movement comes from an East Anglian foundry. "Wondon-worker" writes:—"Some time ago we installed illuminated glass floors in the style of certain London dance-clubs, and these have greatly brightened the atmosphere and tone, and have served as a strong inducement to keep both the foundry and their persons neat and clean. The foundry is also available now for use for dances and other entertainments after hours, at the current rates." (Scottish founders, please note!)

Marksman.

## Correspondence.

*[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]*

### Mechanisation.

*To the Editor of* THE FOUNDRY TRADE JOURNAL.

SIR,—I see from your Leader, in your issue No. 693 of November 28, reference to a Paper read by Mr. R. Spriggs, of Loughborough, before the Birmingham Branch of the Institute of British Foundrymen, and I think that it might be as well if I write you immediately to point out one or two possibilities of misunderstanding in regard to this Leader.

In the first case, may I assure both you and Mr. Spriggs, that whilst a small length of gravity conveyor as "a nucleus for human-effort economy" might be advisable where any small light moulds are concerned, it would not be advisable where heavy moulds, say weighing anything over 2 cwts., had to be placed upon it. It is a proved fact that the ordinary type of tubular roller conveyor is very little use in a foundry, because, for one reason, the indentation of these tubes becomes an accomplished fact very quickly, especially where heavy weights are put upon them. The only safe way to overcome this is to use the solid roller conveyor, about which Mr. Spriggs, I understand, made no mention in his Paper at Birmingham. At the same time, it is not in every case either desirable or convenient to use roller conveyor in all foundries.

May I also protest against your wording when you say that "Time will undoubtedly see the creation of more foundries of the Morris type." I did not know the continuous casting foundry was a monopoly or a creation of Morris's. This type of Foundry originated in France at the Guise Works, by Monsieur Godin, in 1880, and was first copied in America by the Westinghouse Air Brake Company, who commenced their plant in 1893. No existing company could for one moment claim that continuous casting plants should be called after them, and, consequently, I see no reason why you should designate them "Morris type."

My opinion with regard to the mechanised foundries is that one cannot enunciate any definite concrete rule as to the point where one is to start or stop. Everything depends on such a variety of conditions in Europe that it is impossible to postulate any standard rule. This is, if I may be excused from saying so, the difficulty of the new constructors coming into the trade at the present time, namely, that they are trying to visualise continuous casting foundries in Europe as comparable with those in the United States of America. We can never have the same conditions in Europe, except in very rare cases, such as the Morris Motor Company, of Coventry. Other plants in Great Britain have to be studied individually, and, as a proof of this, my firm personally have made thirty-five lay-outs in the last six months for firms in Great Britain, every one of which has differed, not in the general principle, but in the general arrangement and types of plant utilised.

I think, at the initial stages of the development of continuous casting plants in Great Britain, one must be very frank with the public and explain to them that every foundry has to have its problems personally and individually studied, and that it is not possible to lay down any concrete and definite laws which will be applicable to any and every foundry.—Yours, etc.,

AUSTIN S. BEECH,
Director.

The Universal System of Machine Moulding & Machinery Company, Limited.

December 3, 1929.

## Catalogues Received.

**Nut Fastener.**—We have received from Messrs. Kraberhall, Inc., of Land Title Buildings, Philadelphia, Pa., U.S.A., a leaflet detailing an interesting arrangement for securing nuts on bolts. The security is effected by driving into triangular grooves, machined from the top edge of the nut to the thread, a headless triangular-shaped pin. This system appeals to us as being serviceable and economical.

**Tool Steel.**—We have received from Edgar Allen & Company, Limited, Imperial Steel Works, Sheffield, a well-illustrated 32-page brochure dealing with special alloy tool steels. It is not specially designed for foundry buyers, but chilled-roll turners' tool steel (page 6) and pneumatic chisel steel (page 29) are specially stressed. We think it would be a useful and gracious compliment to the foundry industry, of which the Edgar Allen concern is so distinguished a member, if the firm would prepare for that industry a special catalogue for itself. This would deal with the steels and tools they make for the steel, iron and non-ferrous foundries for the fettling, finishing and patternmaking sections.

The booklet under review deals with a range of tool steels other than high-speed and ordinary plain carbon steels. These constitute a very large and important section of the tool-steel business, and are typified by the examples dealt with in the brochure. Other related activities are steels for ball bearings and races, wortle plates, various machine knives, balance beams, etc. If we interpret the message of the booklet correctly, we endorse that it is desirable that the choice of a steel for any purpose other than well-known routine jobs can often best be left in the hands of the manufacturer.

**Pig-iron.**—Foundry managers and metallurgists and manufacturers of malleable castings will find considerable interest in a brochure recently published by the Workington Iron and Steel Branch of The United Steel Companies, Limited. This contains notes of the various grades and brands of pig-iron made at the Cumberland Works, notably the "Distington," "Workington" and "Harrington" brands, together with some excellent photographs of fractures and complete analyses of all grades. We have previously pointed out, however, that brochures carrying illustrations of pig-iron fractures should be printed on white, not tinted paper, as a sharper differentiation is effected. Then we confess to a second fad, that is, we like to read compositions in the following order—carbon, silicon, manganese, sulphur and phosphorus. The brochure, which is of the type one keeps for reference, stresses "personality" and "body" of their brands of pig-iron; but this is not the place to develop the subject, and we will confine ourselves to a general statement that the latest scientific research tends to justify these age-old claims for "inherent properties" of an ameliorative character. The firm is to be congratulated on the creation of a panel of technical experts to advise founders upon their mixtures.

This booklet (W109) is available to our readers on application to the Publicity Department, The United Steel Companies, Sheffield.

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MR. ROBERT WOODWARD, one of the founders of the firm of Edgar Allen & Company, Limited, Imperial Steelworks, Sheffield, and chairman of the company since 1915, has resigned his seat on the board of directors. Mr. Woodward is 86 years of age. Mr. William Crosby, the deputy-chairman of the company, after 40 years' service with the firm, has expressed a desire to resign this office and his managing directorship in June next year. As a result of these changes, Mr. Charles K. Everitt has accepted the position of chairman in succession to Mr. Woodward. Mr. Everitt has been associated with Messrs. Edgar Allen & Company, Limited, since 1881. He eventually became manager of the steel department, and was made a director of the company in 1908.

## The Engineering Industry.

### INABILITY TO PAY HIGHER WAGES.

The reasons given by Sir Allan Smith, chairman of the Engineering and Allied Employers' Federation, for the refusal of the claim by the unions for an increase of wages, have now been published. With regard to the industry's ability to pay increased wages, Sir Allan Smith said that in 1928, compared with 1927, the industry did not increase its earning capacity by ½ per cent. He pointed out that prices were lower; competition was keener; new competitors were in the field; old markets were being lost and there was increased competition in those that remained. Foreign countries were manufacturing for themselves as well as for abroad; the Colonies were becoming more self-supporting; the Dominions were sending their orders to Germany and America in very large amounts; municipalities in this country were getting their gear from Switzerland and Germany; foreign tenders were being used to depress the home prices below the remunerative stage; costs were higher than those of foreign competitors, and hours were, in the main, less. Taxation was higher; fair wages clauses applied in this country, but they did not apply to competitors. Longer and even impossible credits were being demanded in exchange for the granting of orders. All these external difficulties had their effect on home competition, which was now getting desperate. Also, there was the large and increasing burden represented by social services, the revenue for which was £63,000,000 in 1911 and £379,000,000 in 1928.

Sir Allan Smith quoted figures of earnings in the engineering industry derived from an ascertainment of the actual earnings of the skilled and the unskilled men in March of this year. The results of the inquiry are summarised in the following table:—

| Classes of workpeople. | Average basic time rate.* | Average weekly earnings. | |
|---|---|---|---|
| | | Time workers. | Piece workers. |
| | s. d. | s. d. | s. d. |
| Fitters .. .. | 58 1½ | 66 1½ | 79 2 |
| Turners .. .. | 58 1½ | 63 3½ | 78 4½ |
| Pattern-makers .. | 62 2½ | 66 11 | 78 7½ |
| Moulders .. .. | 61 1½ | 62 1½ | 74 10½ |
| Platers, riveters and caulkers .. .. | 59 10½ | 63 9½ | 84 4½ |
| Labourers .. .. | 41 10½ | 48 11½ | 56 10½ |
| All classes of engineering operatives, skilled, semi-skilled and unskilled .. | — | 58 9½ | 73 11½ |

* Inclusive of war bonus.

## Company Meeting.

**Sheffield Steel Products, Limited.**—The annual meeting of Sheffield Steel Products, Limited, was held recently at Sheffield. MR. C. P. JOHNSTON, who presided, said that on medical advice he was relinquishing the chairmanship of the company, and in future would fill the position of deputy-chairman. Sir Halford J. Mackinder would take his place as chairman. Reviewing the position of the company, Mr. Johnston said that it was no small achievement to have turned a company which was trading at a substantial loss five years ago into one which now showed a trading profit of £46,000 and a net profit of over £40,000. He said last year that they were extending their original business in various new directions. This policy had proved advantageous and promised to be even more so as time went on. Conditions were very uncertain with regard to some of the trades for which they catered, but up to the end of last month their estimated profits showed a satisfactory increase over those of last year.

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THE FOLLOWING FIRMS have been elected members of the British Cast Iron Research Association: Renwick & Company, Limited, Bengal; the Shotts Iron Company, Limited, Edinburgh; the Atlantic Engine Company (1920), Limited, Wishaw, Scotland; and Ashmore, Benson, Pease & Company, Limited, Stockton-on-Tees. Mr. John Hird, Dursley, Glos, has joined as an Associate member.

# Steel Castings.

By C. Howell Kain.

(*Continued from page 404.*)

## PART II.—Practical Desiderata.

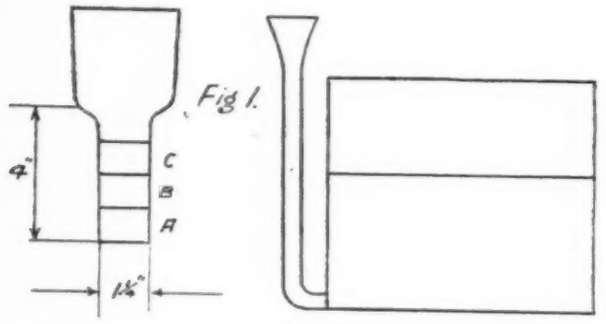
After the method of making the steel to the required specification and composition has been decided, the problem of making a satisfactory casting arises. Mr. Jefferson, in his Paper read to the Scottish Conference on "Steel Castings," showed that even if all the sections of a casting are perfectly uniform, it does not follow that all parts of the casting have exactly the same mechanical properties.

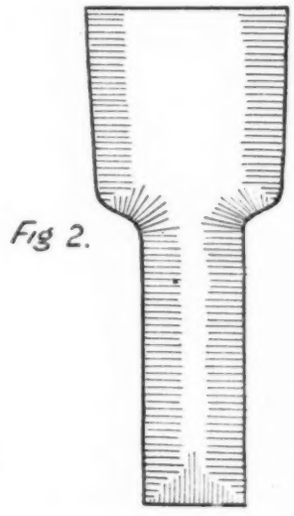
After reading that Paper a number of standard shop test blocks were tested to ascertain the variation in the different bars. Fig. 1 shows the shape and dimensions of this block. The tongue is large enough to allow three 1¼-in. square bars to be cut. One for the tensile test, one for the bend test, and one for a standby in case of failure with either of the others, or in case of hidden flaws being discovered. In the experiments all three bars were turned to the standard B.E.S.A. dimensions for tensile test pieces, and pulled. They are marked A, B and C, from the bottom upwards.

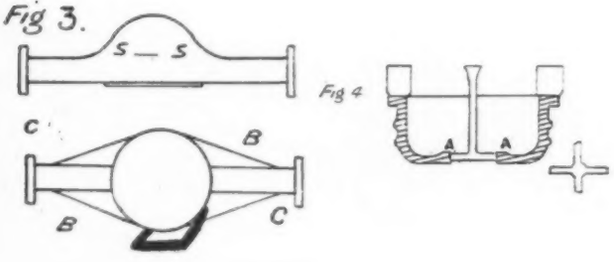
Table III is a fair illustration of the results obtained. Many bars were tested and the same variation was always found. Bar "A" gives the best result; bar "C" the next best, and bar "B" the worst. The difference is shown most by the elongation; the other properties being fairly uniform. Similar results were obtained by cutting three bender bars from the block.

Table III.—*Tensile Properties of Continuous Test-Bars.*

| Position. | Y.P. Tons/sq. in. | M.S. Tons/sq. in. | E. Per cent. |
|---|---|---|---|
| A | 20.48 | 31.80 | 34.0 |
| B | 21.06 | 31.48 | 24.0 |
| C | 20.28 | 31.18 | 28.0 |
| A | 20.28 | 33.64 | 31.0 |
| B | 19.72 | 33.52 | 22.0 |
| C | 19.40 | 33.04 | 26.0 |







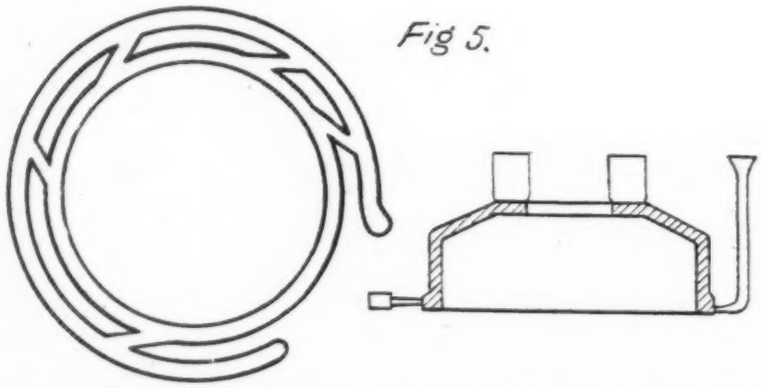



Fig. 1.—Test-Bar for Steel Castings.
Fig. 2.—Possible Freezing Conditions for the Test-Bar (Fig. 1).
Fig. 3.—Back Axle Case with Defect at S—S.
Fig. 4.—Bottom-Run Brake Drum with Defects at A—A.
Fig. 5.—Successful Method of Running Casting shown in Fig. 4.

### Difference in Properties Explained.

In Fig. 2 an attempt has been made to show the position diagrammatically just before the final freezing of the block. As the metal cools it freezes in a continual thickening envelope on all sides. The first crystals or dendrites formed conduct the heat away from the liquid in the centre, which then solidifies and carries the process a little further into the remaining liquid. A point is very quickly reached when there is a very thin column of liquid metal in the centre, and the heat is conducted away from this so rapidly that crystallisation starts almost simultaneously down the full depth from centres independent of the original dendritic walls. As these last crystals form they contract and rely on the liquid falling by gravity from the head to feed the minute spaces left, but the pressure and fluidity of the metal left in the head is only sufficient to force its way a short distance down. It will be seen then, that since bar "A" freezes from three sides, it consists entirely of primary crystals, whilst the centres of bars B and C consist of secondary crystals. The feed metal from the head has fed bar "C" efficiently, but not bar "B," and although bar "B" appears to be perfectly solid, it seems logical to conclude there are tiny microscopical spaces between the crystals. The obvious thing would appear to be the use of a block of two bars only, and many people do this, but although no difficulty is experienced in meeting the requirements of Inspectors, it is best to have a third bar, since the block must be attached to the casting, and the metal has often a considerable distance to run before entering the test block, and there is always the possibility of collecting dirt and so causing a flawed bar, which will affect the test.

### Overcoming Practical Difficulties.

In addition to all the metallurgical difficulties there are many awkward problems to be solved by the moulder. Quite apart from questions of refractoriness of the sands employed, blowholes due to water, etc., the gating and feeding of the casting presents problems not met with in other metals. Such devices as the use of chills, both external and internal, nails of various sizes, etc., are very widely used in attempts to equalise the cooling rates and prevent cracks and shrinks. Unfortunately, a chill used to prevent a defect in one place may so hasten the cooling there as to prevent adequate feeding elsewhere, and so a defect develops in a previously sound spot. Although in many cases it is not possible entirely to eliminate the use of chills, often a careful study of the casting and the disposition of the runners would minimise their use.

The advantages and disadvantages of top and bottom running, cold casting through large gates, hot casting through small gates, etc., have been very widely discussed, as has also the necessity of providing collapsible cores, freeing heads and runners, etc. Therefore, it is not proposed to discuss these at length, but to give a few instances in which these principles have been applied.

### Back Axle Case.

Fig. 3 shows an instance of a very puzzling defect. The casting is an automobile back axle case, ¼ in. thick, and the runner was originally placed to run straight into an internal flange at the bottom. The castings were perfectly clean and sound, but had an unsightly cold-shut mark, as shown at "SS." This was apparently due to metal running into the bottom, filling the mould to the level of the arms, when the internal gas-pressure prevented the metal rising uniformly all round the body, and so the hotter metal on the side nearest the runner filled the mould quicker and flowed over the top of the core to join the metal on the other side. Running from two separate ladles was tried, as shown at "BB" and "CC," but although the defect moved its position somewhat, it was still present, and trouble was also encountered with sandy places in the bore. Placing the runner in the bottom, with the two gates running tangentially into the flange then overcame the

trouble, probably as a result of the metal having a definite velocity in one direction.

Fig. 4 shows a brake drum in section. This was run, as shown, from the bottom, with heavy feeders on the top flange, but although the braking face was perfectly clean, there were large holes in the lugs "A" owing to entrapped air and gases. This is a type of defect very commonly encountered in small lugs, and is usually classed as a shrink or "draw," but a careful study of the sections of metal involved will often show that the hole is much too big to be a pure shrink, and must be partly the result of entrapped air.

After many trials the drum was turned over, as shown in Fig. 5, and an annular runner made round it. A number of very thin knife-edge ingates led into the casting, and from this runner perfectly sound and clean castings were obtained. There was, of course, a possibility of cracking owing to the annular runner acting as an extra heavy flange, but this was overcome by making the ingates so thin that they cracked rather than the casting, and in many cases, when the casting was removed from the mould, the main runner and the casting itself were held together only by one or two sound ingates.

### Pencil Gates cure a Drum Casting Defect.

Fig. 6 shows a drum casting which is machined all over. As the castings must be perfectly clean, bottom running was decided on, but trouble was at once experienced in the heavy section at the centre, and also with cracks in the small bottom flange. Chills and nails were tried, but this in turn led to further defects, resulting from sweating of the nails and burning of the chills. Tangential running at the bottom partially overcame this, but did not stop the cracks in the bottom flange, whilst tangential running from the top gave sound but very dirty castings.

It was then decided to try top running through pencil gates. Five $\frac{3}{8}$-in. gates were used, with two heads. The castings were perfectly clean and sound, and no chills or nails were used. The weight of the old runner was 45 to 50 lbs., whilst the present runner and heads weigh only 24 lbs., and in addition to the saving of metal, there is a saving on the moulding time owing to the elimination of chills and nails.

Fig. 8 shows another brake-drum casting which is machined all over. For the sake of cleanness, these were run from the bottom, as shown, but, whilst the castings were perfectly clean, they had nasty shrinks in the corners of the lug. Chills and nails were tried without success, and tangential runners were a failure, as the castings were dirty. Top pencil gates were then decided on. Fig. 9 shows how these were arranged. Five runners, $\frac{5}{16}$ in. dia., were used, and, although at first some trouble was experienced with cold shut, the castings were afterwards made quite successfully. The weight of the bottom runner and heads was 30 lbs., and the pencil runners and heads 20 lbs., so a saving was again made in both metal and labour.

### Split Runner clears up Defect.

Fig. 10 shows a casting which gave trouble owing to cracks near the runner. The centre portion consists of a heavy H-section, lightened by cored holes and with two heavy trunnions on the end. Cracking webs, easing the heads, soft ramming, casting from both ends, were tried without success. The best results were obtained by casting from both ends, but then occasional trouble was met, with cold shuts in the centre.

The runner was then split as shown in Fig. 11. The casting is now poured from one ladle through the down gate R, and immediately pouring is finished the cross-gate is broken at B, and a whole bush and runner pulled off at the level XX. This, of course, tends to make a splash, but the cracks have entirely disappeared.

### Pencil Runners Effective for Bomb Bodies.

Fig. 12 shows a bomb body which had to pass a very rigid inspection for smoothness of finish, etc. There was a range of these, 12 in. to 3 ft. 6 in. overall, and the heaviest weight was $2\frac{3}{4}$ cwts. They were run from the bottom with an extra runner into the feeding head, but the castings were not sufficiently smooth, especially near the runner at the bottom. Several ingates at different levels were tried, but with no success, and it was decided to cast through very small bottom gates.

Fig. 13 shows how this was done. The down gate was $1\frac{1}{4}$ in. dia.; the circular channel at the bottom was also $1\frac{1}{4}$ in. dia., and connected to the casting through five $\frac{3}{8}$-dia. ingates. Rather surprisingly, no trouble was experienced in running, and in very few instances did the pencil gates freeze before the mould was full, and in all cases the castings were very much cleaner and smoother than those made by any other method.

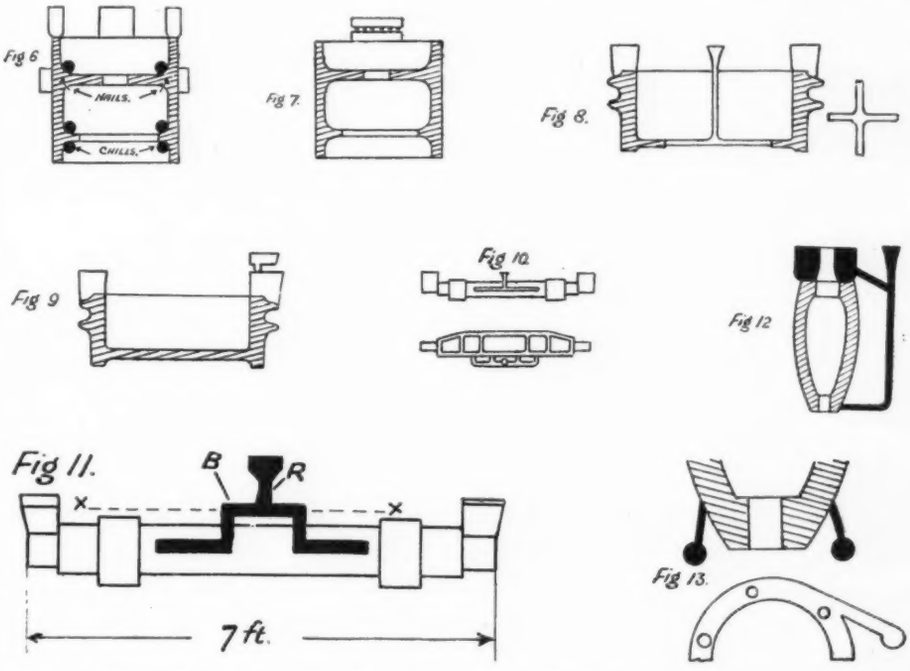



FIG. 6.—DRUM CASTING SHOWING VARIOUS DEFECTS.
FIG. 7.—PENCIL GATES WHICH EFFECTED AMELIORATION IN FIG. 6.
FIG. 8.—DRUM CASTING WITH DEFECTS IN THE LUGS.
FIG. 9.—SUCCESSFUL METHOD OF RUNNING FIG. 8.
FIG. 10.—CRACKS BY THE RUNNER SPOILT THIS CASTING.
FIG. 11.—THE SPLITTING OF THE RUNNER AS SHOWN EFFECTED A CURE.
FIG. 12.—A BOMB BODY SHOWING POOR SURFACE DUE TO RUNNERS.
FIG. 13.—THIS METHOD OF RUNNING PROVED SUCCESSFUL.

### DISCUSSION.

The BRANCH-PRESIDENT, who opened the discussion, was not prepared to accept Mr. Kain's explanation as to why the top and bottom test-bars, shown in Fig. 1, were better than the middle test-bar. If the three test-bars were made at the same time, and the metal was run from the bottom, as had been done in this case, it was natural that the sand at the bottom of of the mould must be heated to a very much greater extent than that in the other parts, and he could not agree that the metal at the bottom of the mould would freeze faster than would the superposed metal. His view was that the test-bars at the top and bottom were more heated than the one in the middle, and probably would cool more slowly than the middle one. Discussing the occurrence of cold shuts in castings, he said it was his experience that it was best to cast with single runners wherever possible. He admitted, of course, that in many cases the size of the casting to be produced rendered it necessary or advisable to use a double runner, but then one was liable to produce a cold shut at the point where the two streams of metal met, possibly due to the oxidation on the surface of the liquid metal preventing the two streams from welding together properly when they met. The problem of sorting steel scrap was a very important one, because all foundrymen, whether they admitted it or not, were using steel scrap, and it was particularly difficult to get any definite composition. As the result of the introduction of alloy steels, which often were put on to the market merely with the object of increasing the price, the makers of plain steel castings were experiencing difficulties, and it would certainly be worth while paying a little extra for steel scrap if its analysis could be guaranteed.

MR. V. C. FAULKNER (Past-President) said Mr. Kain had not mentioned the phenomenon, in basic electric steel practice, of the return of the phosphorus to the bath after slagging. He (Mr. Faulkner) had spoken on this subject at a symposium organised by several of the scientific societies, and had postulated that in ordinary basic electric furnace practice a figure of something like 0.009 per cent. of phosphorus was reached; the bath could be slagged very carefully, and, when a final analysis was made, it would be found that there was about 0.02 per cent. of phosphorus in the finished article. Prof. C. H. Desch, who had led the discussion, had stated that the return of the phosphorus was due to the inefficiency of the melter, who did not clean the bank sufficiently well, and the first slag, carrying phosphorus, was reduced. It so happened, however, that he (Mr. Faulkner) was present during experiments in which two furnaces were used, one being at a higher level than the other. The primary furnace was stationary, and was tapped by means of the ordinary tap-hole. The metal then ran into the second furnace, and, as soon as any sign of slagging appeared, a "Y" arrangement diverted it

to a slag pool. The materials used for the second slagging were free from apatite (calcium phosphate), and all the other materials were carefully analysed for phosphorus content. He was convinced that there was no definite line of demarcation between liquid metal and slag, and that there was some area in between which contained both slag and steel. He asked if Mr. Kain would agree that the most difficult steel for making sound steel castings was that containing a minimum of carbon. The only place at which he had seen castings of this particular steel made really satisfactorily was in Switzerland. The practice was to remove the electrodes from the furnace, or partially to remove them, to open all the doors and allow the steel to cool down to almost a pasty stage, and then to put the furnace into action again and re-heat the steel. The process had come to be known as the Archbutt process, but Archbutt allowed his alloys or his metal to freeze down completely. He (Mr. Faulkner) did not think it necessary to cool low-carbon steel completely; if it were cooled to the pasty stage, there was a very large evolution of gas, and the resultant metal could be cast quite easily.

That afternoon he had seen for the first time a system by which the alloys added to the steel in the ladle were added in a wet condition. The wetting resulted in an explosion when those alloys were added to the steel, and, unless quite a good explosion occurred, the foundry manager was not satisfied that the steel was satisfactory. It would be interesting to have some logical explanation of that. He had learned that eight grades of sand were used at the Kryn & Lahy foundry, but it would be interesting to know whether, in a foundry making rather smaller types of castings, that number of grades was reduced. At the Milan Steel Foundry Company's works there was a series of bins containing facing sands, certain grades being used for certain weights of castings. The gradings were for weights of 0.5, 1, 5, 10, 25, 100, 250 and 1,000 kilos. He asked Mr. Kain if he had any analogous standard for grading sand. Also, inasmuch as the castings produced by Mr. Kain were perhaps lighter than those produced at Letchworth, he asked how much sand he used per ton of castings. At Letchworth they prepared 1 ton of sand for 1 ton of castings, though sometimes the amount used was reduced to 17 cwts.

Mr. Cochrane asked if Mr. Kain had experienced any difficulty in the running of nickel-chromium steel in steel castings; he had in mind alloys containing something like 2 per cent. of chromium and 3 per cent. of nickel, and possibly a rather higher carbon content than that of the steels which Mr. Kain appeared to be using, judging by the figures he had put forward in the Paper. Dealing further with the figures given, he said that the yield point appeared to be rather high in relation to the tensile strength, and he asked whether the test-pieces were subjected to a sustained load for a period of 10 secs., or whether the tests were just visual tests.

Mr. Kain said they were visual tests.

Mr. Cochrane said he gathered that the yield point would be about 17 tons.

Mr. Kain agreed that it would be somewhere about that figure.

Dr. A. B. Everest referred to the question of the inclusion of alloys in steel, and mentioned that he was interested in this point in connection with the possible inclusion of alloys with cast iron or steel scrap introduced into the furnace. This would arise particularly if alloys were used as additions to hematite iron in ingot moulds in order to improve the life of the mould. It seemed that experience showed that chromium was liable to give trouble in the melt, since in particular it thickened the slag. He asked Mr. Kain if he had had any experience of the inclusion of nickel in steel to the extent of, say, up to 0.5 per cent., and, if so, whether in his experience it had upset the working of the furnace and perhaps the heat treatment of the metal after casting.

He also asked if Mr. Kain had experience of the use of nickel for improving the quality of steel castings. In this connection reference was made to an occasion on which one or two foundries had been asked to make some Diesel frames in steel, but had met extraordinary difficulty in making these frames sound. The difficulty had been such that ultimately cast-iron frames were used, although initially steel had been specified. One particular foundry, however, which had a very good name, had experimented, and had ultimately produced a sound cast frame in steel in which had been included about 3 per cent. of nickel and 0.75 per cent. of chromium. He gathered that by the use of the alloys greater soundness had been obtained in the steel castings. Not only were the castings sounder, but they were also more reliable, and mention was made of the fact that the Canadian Pacific Railway Company was actually using cast-steel locomotive frames containing 3 per cent. of nickel, which latter was added in order to secure greater ductility and reliability.

Mr. Langley, commenting on the methods adopted by Mr. Kain for the running of valve castings, said he would like to hear what methods were adopted by others, and what conclusions they drew as the merits of their own and Mr. Kain's methods.

Mr. H. C. Dews expressed a little disappointment because, although Mr. Kain had referred to the effects of silicon and aluminium in steel, he had not given an explanation of those effects. He asked Mr. Kain what did happen when silicon and aluminium were added to steel. The diagram illustrating the casting of the three test-bars mentioned in the Paper, and showing the results of the tests made on those bars, should commend itself to the practical foundryman as being worthy of a great deal of consideration. He believed Mr. Kain had given the correct explanation of the variation in the test results obtained from the three bars, and that the freezing diagram exhibited was such as might be expected. The use which Mr. Kain had made of pencil runners, however, was somewhat surprising, and he had wondered why Mr. Kain had used pencil runners as illustrated. The pencil runner was meant to be used to run a casting sufficiently slowly to allow the casting to become solid when the running was completed, and to enable one to dispense with the use of risers. Mr. Kain, however, had run the metal into the riser by means of pencil runners, and in so doing appeared to have defeated the object of using pencil runners. If the pencil runners were used for the sake of getting clean metal into the castings, one could understand their use, but if they were used to minimise the feeding head, he could not see how that worked, and would like a little further explanation.

Mr. J. H. Nunns asked what useful purpose was served by casting the test-bar at a position somewhat remote from the down runner. It seemed to him that, when the metal reached that position, it was inclined to be sluggish. With regard to Mr. Kain's use of pencil runners, he suggested that they were used principally for their straining or skimming effect, and not intended for use on the Ronceray principle.

Mr. H. O. Slater said that Mr. Kain's remarks concerning the use of pencil runners recalled to one's mind a Paper on the subject, read in 1921, by M. Ronceray, and the criticism which had been heaped upon him. Although he (the speaker) had felt somewhat in sympathy with M. Ronceray when he had told one of his critics that he had obtained success with pencil runners, but did not know why, the fact remained that he had left his critics to explain scientifically for themselves the reasons for his success.

With regard to the casting of the axle case illustrated by Mr. Kain, the speaker pointed out that the running of the metal into the casting in two different directions was definitely opposed to the principles of practical moulding, and the successful production of the casting ultimately was due to the fact, of which any moulder was aware, that the method of pouring in one direction only was much more efficient. He had been pleased to note that pencil runners had been used so successfully, and the success achieved by Mr. Kain was further proof that the statements made by M. Ronceray in 1921 were right. He (the speaker) had tried it not only for cast iron, but also for non-ferrous metals, and knew it had been successful even in the running of billets, and the effect had been not only to reduce the melting costs, owing to reduction of dead heads, but also the amount of labour. He had not tried it in casting steel, and there seemed to be a wide field for it. He believed the reason for its success was that it brought about equal distribution of metal, and, therefore, more regular solidification. Further, the metal must be really hot.

### Author's Reply.

Mr. Kain, replying to the discussion, said he was sorry the Branch-President had not agreed with his explanation of the test-bar results, but he was pleased that Mr. Dews had agreed, because he must admit that in giving that explanation he had been inspired largely by a Paper on bronze castings, read by Mr. Dews at the London Convention. It seemed rather a long cry from bronze to steel, but he was convinced that the explanation was at least very feasible. He agreed that the running of metal into a casting from two places might be fundamentally wrong, inasmuch as it tended to produce cold shuts; but, in making steel castings, and particularly thin steel castings, the principle of having only one ingate was not adhered to. It was the best practice to secure the entry of the metal into the casting at a number of different points, if possible, in order to ensure even cooling.

Discussing the phenomena of the return of the phosphorus, mentioned by Mr. Faulkner, he said that undoubtedly it did occur, but in basic electric practice to-day there is no difficulty in keeping the phosphorus content to within the limits specified by all the inspecting authorities, so that he did not think the question really arose seriously, unless one's object were to make a very pure steel for some special purpose, such as replacing Swedish iron. He had never adopted the practice of wetting the alloys before adding them to steel, as all additions are made to the furnace, but he understood the object of wetting was that, whereas when they were thrown into the ladle in the ordinary way they tended to float in the slag, if they were wetted beforehand, the water would form steam, which caused an explosion and allowed the alloys to pass through the slag into the metal. As to the use of different grades of sand, he said that for years, in a foundry producing castings the weights of which varied from a few ounces to 1½ tons or thereabouts, the same sand was used for all the castings, except the very heaviest. The sand used for dry-sand moulds was very similar to that used for green-sand moulds, the chief difference being the addition of molasses, and in some cases linseed oil. The sand problem was one on which steel founders required more information. As an instance of the difficulties experienced, he said he had known a case in which castings, when run in one particular place, were very sound, but, unfortunately, each had a crack and occasionally came out of the mould in two pieces. They were moulded in a synthetic sand built up from a pure silica sand and a natural fatty clay. Since then a naturally-bonded sand had been used, and the castings had been made perfectly well and free from cracks.

Replying to Mr. Cochrane's question as to the fluidity of nickel-chromium steels, he said he had very little experience of the 2 per cent.

chromium, 3 per cent. nickel class of steel. At his foundry, however, they were melting and casting stainless steels containing very much more chromium than that; they were not made in a basically-lined arc furnace, however, but in a crucible type of furnace. It might be, as Dr. Everest had stated, that the inclusion of nickel rendered a casting more uniform and more reliable, but he himself was not making any low-nickel steels at the moment. But the inclusion of nickel did definitely affect the heat treatment required. The average heat treatment of light steel castings was to normalise at about 900 deg. C. If scrap containing nickel were used, and if the nickel appeared in the castings, then the test results obtained were different from those anticipated.

Dealing with Mr. Dew's question with regard to the action of silicon and aluminium, he said he did not think there was any doubt that, when the silicon was added to the bath after the removal of the oxidising slag, it reduced the ferrous oxide and formed silica. But the occurrence of gases had also to be borne in mind. Silica was insoluble in the steel, so that it could not have any effect, and it was very probable that a certain amount of the silicon added after the ferrous oxides were removed increased the solvent power of the steel for gases, and so rendered the steel sound, but that action could not take place until all the iron oxides had been reduced, either by silicon, manganese, or by the action of a reducing slag. Aluminium acted in a very mysterious manner in increasing the solvent power of steel for gases. It was not used anything like so widely in this country as in the United States. He was afraid that the steel-making methods in the States were rather slipshod, and that they tended to make the steel in the ladle rather than in the furnace. Last summer he had had sent to him a piece of steel, about 2 in. in diameter, having a very pronounced columnar structure. The columnar crystals were about $\frac{3}{8}$ in. long and about $\frac{1}{8}$ in. in diameter, and were the biggest he had ever seen in a steel casting. The Americans who had produced the steel had stated that they were getting that structure repeatedly, and that no amount of heat treatment would remove it. The steel was analysed, and it was found that the percentages of carbon, silicon and other constituents were normal, except that the steel contained also 0.34 per cent. of aluminium, which latter, of course, had accounted for the structure. If founders would add enormous quantities of aluminium to a mild steel such as that, they must expect trouble.

The reference in the Paper to the use of "pencil" runners seemed to have caused some surprise. Strictly speaking, the expression "pencil runner" ought not to have been used in this connection, because, as Mr. Dews had pointed out, the object of the pencil runner as introduced originally by M. Ronceray was to enable the casting to be poured so slowly that it would freeze as it was made, and so eliminate heads. In the cases referred to in the Paper the object was to obtain hot metal in the head, and at the same time to spread out the runner. If the metal were led into the mould by means of a runner into the head, there was one stream of metal entering the mould through the head, and the heat was concentrated in one small place. If a runner 1 in. by $\frac{3}{8}$ in. were used, an area of 1 in. of sand would be burned. By splitting up the runner into five or six small ones, spread along the length of the head, 6 in. or 7 in. long, one was able to spread out the burning effect of the metal, and there was much less burning-on of sand under the head and runners, and, naturally, far less inclusions.

Replying to Mr. Nunn's question as to why it was necessary to have the test-bar placed so far away from the down gate, he said that depended upon the design of the casting. In many cases, where steel castings of comparatively thin section were being made, if the test-bar were near the down gate, or near the casting at the point where the metal entered from the ingate, a hot spot was produced; there was a large block of metal which remained hot long after the casting had set, and the result was a tear, or possibly a shrink. It was necessary to place the test-bar in such a position that it would not affect the casting. At the same time, it must definitely be attached to the casting; otherwise the inspectors would not accept it.

Another member had taken him to task rather seriously in respect of the runners used originally for casting the axle case referred to in the Paper. He believed it was an accepted principle, at least in steel founding, that the ingate must lead into the casting in such a manner that the metal could run into the casting and "get away" quickly and cleanly. The axle case in question had an internal flange; owing to the design of that flange, and also to the fact that there was a core taking out the centre, the use of two runners in the same direction would have introduced difficulties, because, while the metal coming through the first runner would run round the flange and could "get away," the metal coming through the second would play directly on to the core and could not "get away." For that reason it was decided to use two runners, but each running the metal into the flange in opposite directions, although he agreed that that was fundamentally wrong. Trouble was experienced, however, and the method had had to be modified.

On the motion of Mr. Turner, seconded by Mr. Marshall, a hearty vote of thanks was accorded Mr. Kain for his Paper.

## Iron and Steel Plant for South Africa.

### TENDERS FOR EQUIPMENT INVITED.

Details have become available this week of the plant and equipment required by the South African Iron & Steel Industrial Corporation, Limited, for erection at Pretoria. For tendering purposes the requirements of the Corporation have been divided into three parts—blast-furnace department, open-hearth steel-melting department, and rolling-mill department.

The plant and equipment required under the first head comprises blast furnaces, hoists, ore and coke stockyard, bunkers, etc., hot-blast stoves, chimneys, pig-casting machine, cast-house cranes, auxiliaries and electrical equipment. Requirements in the steel-melting department consist of open-hearth furnaces and mixer, chimneys, gas producers, buildings, cranes, auxiliaries and electrical equipment. The rolling-mill department requires a blooming mill, rail and structural mill, medium structural mill, plate mill, merchant and rod mill, soaking pits and furnaces, chimneys, gas producers, auxiliaries, electrical equipment and rolls for all mills.

Specifications, schedules, forms of tender and drawings will be obtainable in London on December 12 at the office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2. Saturday, April 12 next, is the last date for the receipt of tenders. Some further particulars are given in our advertisement

## Yorkshire Iron & Coal Company, Limited.

We are informed with regard to the purchase by Messrs. Thos. W. Ward, Limited, Sheffield, of the Ardsley blast furnaces and Tingley Collieries, formerly worked by the Yorkshire Iron & Coal Company, Limited, Leeds, that the special concessions and efforts made by Messrs. Ward on behalf of the workmen at the Tingley Collieries have now borne fruit, and the collieries have been resold to a company which will continue to work coal and find employment for many of the workmen. The blast furnaces at Ardsley and the coke ovens and by-products plant at Tingley are being dismantled, and there is now no hope of these being restarted.

## Modern Welding Systems.

### RECENT PROGRESS.

At a meeting of the Junior Institution of Engineers, held in London on Friday, November 29, MR. W. C. FREEMAN read a Paper on "Modern Welding Systems and Applications," in the course of which he reviewed the advantages of the oxy-acetylene flame and the electric arc as the sources of heat in welding operations.

Until about 25 years ago, the only welding known was the fire weld, but the discovery of acetylene gas had brought autogenous welding rapidly to the front as the means of uniting steel, iron and other metals.

Continuing, the author described various processes, such as resistance welding by the spot weld produced by mechanically squeezing the sheet metal (up to No. 10 gauge) to be united between water-cooled copper electrodes through which an alternating current was passed; the butt weld, where clamps connected to an a.c. supply pressed the edges of the metal together; the seam welder, where rollers carried by long arms performed a similar operation; the rivet heater, where the rivets were held between the jaws of a machine provided with a.c. supply; and, finally, the arc weld, where a steel or other electrode coated with a fluxing material was, by means of the electric arc, melted on to and united with the metal to be joined or repaired.

#### Clean Surfaces Essential.

The proper preparation of the metal was essential to satisfactory work, whatever system was adopted; the surfaces to be united must be clean and properly chamfered to form a groove in which the applied metal could run, and this chamfer should form an included angle of 90 deg. for arc welding and 60 deg. for acetylene. The thermal expansion of metals in process of welding must be remembered; for instance, two sheets to be united must be kept apart a certain distance, depending upon their thickness either by wedges or tacks of welding material, otherwise, as the weld proceeded, the sheets would overlap and prevent a sound job.

The work (continued the author) should, wherever possible, be preheated prior to welding; in the case of small and medium articles, by placing in a charcoal or other stove. Large articles should be heated by isolating the area to be operated upon, by forming a wet asbestos wall or ridge round it and playing upon the included portion with a circular motion of the blow-pipe before the weld itself was attempted. The exclusion of drafts of cold air was essential, as also the use of a welding rod of metal whose melting temperature was suitable to the degree of preheating which it had been possible to give the article. Thus an iron-silicon rod gave the strongest weld if applied to a job which could be thoroughly preheated, whereas a Tobin bronze rod with a bronze flux was more suitable for locally-heated articles. The slow cooling of all welded articles was also essential to good work and the avoidance of stresses.

Brass welding could now be accomplished by the acetylene blow-pipe if a brass flux was mixed with water and plastered on the under side of the piece to be welded and an excess of oxygen supplied to the flame, which then produced a perfectly clean and bright weld.

THE HULL CORPORATION ELECTRICITY DEPARTMENT have decided to adopt a complete system of Hagan automatic boiler control for the five Clarke, Chapman boilers in their new boiler house. Each boiler has a normal evaporation of 80,000 lbs. of steam per hour at a working pressure of 400 lbs. per sq. in. The boilers are equipped with the type "L" chain-grate stokers of the Underfeed Stoker Company, Limited. The Hagan system, which will be designed to control both fuel and air supply in accordance with steam demand, is being installed by Messrs. James Gordon & Company, Limited, Windsor House, Kingsway, London, W.C.2.

XUM

# Patterns for Small Repetition Work.

By "Ecossais."

### Metal Patterns.

To produce castings of reasonably good quality, one of the main essentials is the provision of high-quality metal patterns. Good patterns and moulding machines are just as important to the foundry as accurate dies and automatic machines are to the engineering works. On good-quality work the pattern supplied to the foundry must be considered on the same plane as the tools used for producing the numerous types of insulator mouldings as used on electrical work.

Brass, steel and cast iron are used according to the particular taste of the patternmaker. Brass makes a good pattern and is convenient when repairs or additions are necessary, also taking a good polish. The chief disadvantage of brass patterns is the liability to injury, and the constant friction of the sand quickly destroys the sharpness, this giving a bad appearance to castings made from them. Steel has certain advantages over brass and cast iron, resisting wear better than brass and being less liable to fracture than cast iron. Its liability to rust is, however, a disadvantage, and unless well looked after will soon get pitted. This pitting occurs with cast-iron patterns, but to nothing like the same extent as with steel.

In all cases, and whatever metal is used, metal patterns should be kept in a dry building provided with artificial heat, and kept regularly oiled. When there are large quantities of metal patterns it is possible to have a man in charge full time, so that a pattern can be withdrawn from the stores immediately without waiting for half an hour or more for a hasty and unsatisfactory clean-up. Machine oil is more effective as a preventive of rust while patterns are in the stores, but has the disadvantage of causing the sand to stick. This is not the case with paraffin oil, the latter being generally used for cleaning the pattern when in daily use, and paraffin oil should be used to wash machine oil off patterns before leaving the stores for the foundry. The practice of coating patterns with beeswax is quite good and will prevent rust, but the coating must not be overdone, and, after waxing, paraffin must not be used, especially if fillets have been formed in wax, as the paraffin and wax will form a sticky mixture and wash away the fillets, with the possibility that large numbers of castings may have been made before the absence is noticed. Where appearance is important wax fillets, the filling in of screw-holes with wax, also loosely-attached parts of any kind, should be prohibited.

The first cost of a metal quality pattern may seem rather high, especially if it is machined all over, which is the quickest and most accurate way, filing up being limited to parts only possible with difficulty on a machine and for fitting additional parts on a built-up pattern. Advantage should be taken of drilling machine, planer, shaper milling machines, especially the end or vertical miller, grinders or flexible shafts with special files and tools for cleaning and polishing awkward corners. In this way greater accuracy along with speed will be obtained and lengthy and laborious filing up jobs avoided. Where filing is necessary, the finishing strokes should be given at right angles to, rather than parallel to, the pattern plate. On the whole it would be well to abolish the term pattern-filer and class the man engaged on quality patterns as a foundry toolmaker.

### Modifications for the Benefit of the Foundry.

It is not unreasonable to expect that the foundry should be consulted before the final design of any casting is concluded, especially if large quantities are likely to be required, as slight modifications may mean considerable savings and avoidance of rejects. Too often such consultation is delayed until too late a stage, when modifications are impossible owing to the advanced state of other parts for use with the castings, which it would then be expensive to modify so as to conform to a modified casting.

Minor modifications, such as the amount of taper, lightening-out of relatively heavy parts to prevent drawing, the rounding off of corners in some cases and the making of others square instead of round, may be very important to the foundry. Contrary to the general impression, small shallow facings should be given a more liberal taper than relatively deeper portions of the pattern, the corners being filleted and the upper edges rounded off, especially if the faces are machined. The two former help to avoid dirty faces on castings, and the rounded edge is not so easily damaged to cause pulling up, and if afterwards machined the rounded portion is removed.

In all cases, patterns built up on machined plates give the greatest accuracy, and there are few cases, except perhaps those of ornamental patterns, where this is not possible. Wherever possible dry sand cores should be avoided, especially when the patterns are mounted on good machines giving accurate draws, for, in addition to leaving joint-marks, and the liability of incorrect setting, core setting takes time and cores need making. These remarks do not, of course, refer to cores provided for the purpose of covering projections which would otherwise necessitate a difficult joint and an awkward lift in the top box.

### Wood and White-Metal Patterns.

When very large quantities are not required off a pattern, good results may be obtained from well-finished hard wood patterns, but owing to the shrinkage and swelling of these the castings resulting will vary in size, and if there are core-prints constant trouble will be experienced due to badly fitting cores. If a pattern is required quickly and fairly accurate to size, very good results can be obtained by producing a white-metal pattern from the wood pattern. This can easily be cleaned up and is not subject to the shrinkage and swelling occurring with wood, the disadvantage in this case being the ease with which the white metal can be disfigured.

### Plaster and Composition Match Plates.

There are many castings required in quantities at intervals which do not justify an expensive pattern and where urgency is also essential. These can be quickly made by means of match plates when, on account of irregular joints, the pattern cannot be fixed on standard pattern boards or pattern plates. The match plates so made may be mounted on machines and quick production of reasonably good castings obtained.

When the patterns are shallow, the match plates may be cast entirely of plaster or other composition, but in the case of projecting parts liable to injury, it is customary to cast half-patterns in white metal, with nails projecting on the side to be cast in the composition. Cast iron could be used for these inserts, but are not easily cleaned up. Where the inserts are fairly heavy, holes can be provided for securing them to straps on the back of the match plates by screws.

Where a number of metal patterns are already in existence, these may be used for inserts, and in all cases, whether inserts are used or not, the same precautions as to setting up of patterns as are necessary when making plate patterns must be taken to avoid overhung and undershot places.

Although the ordinary moulding boxes may be used, this is not advisable, as eventually leading to the tying up of useful boxes, the match plates also being very heavy and taking up more room in storage. On this account it is customary to have special frames, from which the match plates can be removed and replaced at will, these being provided with pins or pin-holes like the boxes and split at the corners to enable the match plates to be removed, or a much better way is to have a definite taper on the inside, the opening being smallest on the face side, so that when one or more straps are fitted across the back the matches are held firm and quickly removed. Where such matches are used proper storage must be provided in the way of racks to prevent damage, and, preferably, these racks should be in a dry place.

After prolonged use and before the matches have got into too bad a state, it is advisable to renew by making a special cope and drag mould, then, if necessary, breaking up the old matches to obtain inserts, if any, which are then cast in position to obtain a new match.

When plaster of paris is the material used, it is possible to make a pair of match plates, trim and varnish, and produce castings from them on the same day. Other materials require to stand overnight, and in some cases must be subjected to heat to complete the drying and hardening.

# Malleable-Iron Castings.

### IMPROVED PROPERTIES.

According to an article in a recent issue of "The Iron Age" Mr. Edwin F. Cone states that no longer is the field for malleable iron restricted to the production of small or medium-weight castings. It has been demonstrated on a large scale that castings can now be made successfully of weights and dimensions that heretofore were deemed impossible. Malleable-iron castings have entered a new field. They have been incorporated in the railings for the new Liberty Bridge which spans the Monongahela River at Pittsburgh. The production of such castings is regarded as a decided departure from customary practice and has been successfully undertaken by the Fort Pitt Malleable Iron Company, of Pittsburgh.

It is claimed that this is the first use of this metal for bridge railing in this district, and probably in America. The specification requirements for malleable-iron castings on this undertaking called for a tensile strength of 50,000 lbs. (about 23 tons) per sq. in., with an elongation of 10 per cent. No trouble was experienced in meeting these specifications, and, indeed, different casts showed remarkable uniformity. The actual physical results of the material incorporated in the posts and railings approximated 59,000 lbs. (26.3 tons) per sq. in. with a yield point of approximately 39,000 lbs. (17.4 tons) per sq. in. The elongation on 2 in. was about 25.5 per cent., with a reduction of area practically the same.

### Impact Tests on Malleable Iron.

Impact tests upon the malleable iron showed some interesting results. These were made on cast wedges ½ in. by 1 in. at the base, and tapered down to what was practically a knife edge, over a length of 6 in. The method of making the test was to clamp the base of the wedge in a vice, holding it in a vertical position, while a weight was repeatedly dropped upon it, which produced a blow of about 70 ft.-lbs. The result was that the wedge curled in the form of a scroll in almost every case, and an average of 33 blows was obtained in these tests. No fracture was detected in the wedges. Both tensile and impact tests were made on every heat which was incorporated in the castings for this bridge.

The castings are described as highly suitable, and it is stated that the engineers are satisfied with the excellent physical qualities and the severe impacts which the castings have withstood in all the tests.

# Chain Drives in the Foundry.

By "Kilowatt."

Ordinarily in a discussion of the various forms of drives, power saving is emphasised, and while this is important, it is secondary to the possibilities of increased productiveness of machines or of lessening productive losses, as power costs are small in comparison with labour costs. Any drive, therefore, which will prevent loss of time in production, or will result in increased production, will justify its application, irrespective of initial cost. Such a drive must necessarily possess the virtues, the reliability and, so far as the foundry is concerned, be able to withstand the adverse conditions that exist in the operation of portions of the plant, and it is in this direction that we find the application of chains in the foundry as a means of power transmission from prime mover to driven machine of particular value.

There are two distinct types of chain drives used: the inverted tooth type and the roller type. The roller type is of the same form as the bicycle chain, in that the wheel teeth protrude through the links of the chain. This method is suitable for low-speed driving, but for higher-speed power transmission the inverted tooth chain is desirable. With this type of chain the wheel teeth do not protrude through the chain but engage with the links, much in the same way that a pinion engages in a rack.

The introduction and subsequent wide use of silent chain drives for power transmission has been largely due to the electrification of industry. When water-wheels and steam engines were used as prime movers, their power was transmitted through gears, countershafts and belts to the machine it was ultimately destined to drive. As the electric motor has become more perfect and more convenient, and electric-generating costs have been lowered, it is becoming more and more the standard practice to purchase electric power from central-producing stations. This power may be delivered as needed, directly on individual electric-driven machines or groups of machines. Generally, electric motors operate at relatively high speeds compared to the machines they drive, and, consequently, reducing gear of some sort is necessary to transmit from the motor to the machine; for this purpose belting has been generally used, and, in fact, springs to the mind automatically when the question of power transmission is considered. It is the object of this article to put forward cases where chain driving is the best method of transmitting power, instead of its use being limited to conditions that make it necessary.

The use of belts is so easy and convenient that they are frequently employed when chain driving would be better. Chain driving certainly requires more care in initial erection than belting, but against this can be set forward very appreciable advantages, such as:—(*a*) Shorter centre distance and consequent saving of space, (*b*) bigger ratio of reduction in one transmission, (*c*) higher efficiency, and (*d*) reliability in all atmospheric conditions. These advantages are very real and not merely academic; in fact, greater output during a given time has been freely reported.

### Life of Chains.

The life of chains, of course, depends upon the difficulties of the conditions. It is sometimes longer and sometimes shorter than the life of a belt, governed by the suitability of either for its respective job.

In the instance of a chain having had a comparatively short life, consideration should be given to the service which it has rendered. In some cases a chain drive gives a better product and more of it in a less time than would be the case with belts. This is owing to the nature of the load and other circumstances. Thus, by the time the chains require replacing, they have paid for themselves over and over again. While they live they work and give a big output, and if they do not do this they should not be there. Some drives, such as one from a 20-b.h.p. motor which transmits from 1,000 r.p.m. to 95 r.p.m. on a centre distance of 30 in., work under very strenuous conditions, and normal life would not be expected. At the same time, chain driving is not limited to cases where the conditions are cramped, but it is to be very seriously considered as to the best method even when new foundry plant is being erected.

### Features of Chain Driving.

In general, the advantages of the chain drive may be summed up under these heads:—

(1) The efficiency of a well-designed chain drive is as much as 99.6 per cent. under ideal conditions. Even under ordinary commercial conditions the efficiency can be maintained at over 90 per cent. This efficiency is not appreciably diminished throughout the life of the drive on account of the fact that, as a chain wears, it mounts the wheel teeth and adapts itself to a correspondingly greater and correct pitch circle.

(2) A positive drive is secured, allowing no slip, giving definite ratios and increased and more regular production.

(3) Space required for a good drive is small, especially when compared with belts and ropes. The centres can be such that the wheels just clear.

(4) Smoothness and regularity of turning is very marked. This is due to the distribution of the load over a large number of teeth. Only a small proportion of the pull is ever taken by one tooth, and even this is gradually applied.

(5) Elasticity is secured in a great degree by the sag, the oil film in the chain joints, elasticity of material and the form of the inverted tooth link.

(6) Flexibility of chains is much greater than that of heavy belts, and no effort is spent in bending.

(7) Reliability is a special feature. To ensure a reasonable life, the amount of bearing surface is always such as to give a factor of safety that entirely eliminates chain breakage.

(8) No initial tension is required to secure adhesion to pulleys; this minimises the total pull on the shafts.

### Inverted Tooth-Type Chains.

Inverted tooth-type chains are made up of a series of flat plates with angular projections, which, ground to angles of 60 deg. and in some pitches of chain 75 deg., form the driving faces of the chain.

The principle of the inverted tooth-type chain drive is that of a tooth-to-tooth engagement, the teeth of the chain engaging with the wheel teeth over a considerable proportion of the wheel diameter. The margin of difference between the working load and the breaking load of a chain (which is the safety factor) may seem excessive. The breaking load of a chain is governed by the diameter of the rivet, but the wearing areas are dependent on the diameter and the length of the rivet.

### Notes on Installation and Maintenance.

Chain drives should preferably be arranged horizontal, or inclined not more than 60 deg. when the large wheel is uppermost in the drive, and not more than 45 deg. when the pinion is uppermost. The angles mentioned are those included by a horizontal line and the line of the driving side of the chain. Shafts must be parallel and truly horizontal. A vertical arrangement of shafts should be avoided if possible, as such drives call for special provision in adjustment.

Wherever possible, some means should be provided for the adjustment of shaft centres, so that the slack in the worn chain may be taken up. A greater working life will be obtained if such provision is made. In the case of drives from electric motors, this can be done by mounting the motor on slide rails or on a number of slotted plate washers. The amount of the adjustment should not be less than 1½ times the pitch of the chain. Where adjustment cannot be provided in the case of a horizontal or inclined drive, the chain may be allowed to run until the slack is sufficient to allow the removal of a link.

### Provision for Adjustments.

In the case of a horizontal drive, where the bottom side of the chain is the tight or driving side, provision should also be made for adjustment, either by means of alteration in shaft-centre distances or a jockey wheel engaging the slack side of the chain to keep the two portions of the chain from contact. By using chain wheels of large diameter, relative to centre distance, it is frequently possible to dispense with a jockey wheel in this class of drive.

It is impossible to secure satisfactory results from chain gearing which is not properly installed. The shafts on which chain wheels are mounted must be truly horizontal and parallel to each other. Shaft bearings must be rigid and chain wheels should be mounted as near to the bearings as possible. Chain wheels must be mounted with their teeth in correct alignment and secured from any subsequent movement along the shaft. Failure to mount the wheels correctly or to see that they are rigidly fixed when correctly mounted, will result in destruction of the chain through its plates fouling the wheel teeth. It is detrimental to the life of a chain to attempt to run it too tight. When correctly adjusted there should be a slight sag in the chain.

### Lubrication.

Lubrication of the working joints is essential for chain gearing. The most efficient form of lubrication is to enclose the drive in a case and to pump a constant stream of oil on to the inside faces of the chain from a filter pump. An alternative arrangement is to run the chain through oil. One of the above arrangements is essential when the chain speed exceeds 1,000 ft. per min. When the pinion is below, and is too small to allow the chain to run through oil, an oil-thrower disc on a larger diameter than the pinion may be utilised. For speeds up to 1,000 ft. per min. a drip-feed lubricator may be used, fixed so that the oil drips regularly on to the inner face of the chain. A light or medium machine oil should be used, and one drip provided for every 3 in. of chain width. A light splash guard or case may be necessary for this method of lubrication. Periodic cleaning is of prime importance, and it should be borne in mind that this does not mean merely the removal of external dirt but also the cleansing of every joint and bearing surface. This should be done at least three or four times a year, and more frequently if the chain is working under dirty or damp conditions. To effect this, the chain should be placed in a bath of paraffin oil for an hour or two; it should then be removed and hung up, thus allowing the paraffin to drain off; these operations should be repeated, using a fresh supply of clean oil.

After the chain has been thoroughly cleaned it should be put into a bath of suitable lubricant (which should be kept melted) for several hours, to allow it to penetrate to all the wearing parts of the chain. For roller chains, use tallow or grease of a non-acid character, which will partially solidify when cold; the addition of powdered graphite is an advantage.

XUM

# Alloys Now Cast in Great Britain.

By Thomas Henry Turner, M.Sc.

(*Continued on page 373.*)

## Cast Steel.

Very great progress has been made in recent years in the casting of large and intricate steel shapes. In America, for example, locomotive frames have been cast for modern giant main-line engines, in one piece—both sides, cross-members and cylinders, all forming one monobloc—and in many cases these have been cast in low nickel, or other slightly alloyed steel, and later heat treated.

No corresponding developments have taken place in Great Britain in this connection, because British locomotive designers employ frames built up from rolled plates or sections. It is probably true to say, therefore, that high-tensile alloy steel castings are seldom made in Great Britain, despite the fact that nickel, nickel-chromium, and other such alloy steel forgings, play essential parts in modern engineering practice.

Heat-treated alloy steel castings may be used in the future, but they are not widely used now. Government engineers recently suggested that the British foundry industry was backward as regards steel castings. This may be true, but in view of the outstanding merit of the joint research work on steel ingots recently published by British steelmakers, it is probable that the steel foundries could meet higher demands than engineers are now making of them.

British engineers have always striven for the maximum dependability in their products, and they have feared the uncertainty of possible unsoundness and cracks in steel castings. The latter have, therefore, been displaced to a large extent, during the last twenty years, by forgings and stampings. The author has, however, seen many small steel castings made from small converters in different automobile factories.

He has seen large converters and electric furnaces used for general engineering steel castings in modern steel foundries, which will stand comparison with any visited abroad, and he has seen large steel castings, such as 30 to 40 ton weight flywheels for rolling-mill motors, made from open-hearth furnaces, so as to machine up without indication of the slightest flaw.

The bulk of the steel castings are made of *carbon steel*, which would comply with one or other of the specifications referred to below.

No chemical analysis requirements were placed in the earliest of the relatively few standard specifications for cast steel, which are now in use in Great Britain. The castings must be made from "*Open-Hearth*" *steel* in each of the four grades used for marine purposes (B.E.S.A. No. 30—1907), and one of the grades, "B," in this specification is now also used in girder bridge work (B.E.S.A. No. 153—1922). The mechanical properties required of these steel castings are indicated in table.

Table V.—*B.E.S.A. Cast Steel for Marine and Bridge Work.*

| Grade. | U.T.S. Tons/sq. in. | Min. El. Per cent. | Min. angle of bend without fracture. |
|---|---|---|---|
| A | 35—40 | 15 | 60 deg. |
| B | 26—35 | 20 | 120 ,, |
| C | 26—35 | 15 | 90 ,, |
| D | Not specified. | | |

*Steel castings for railway rolling-stock* are only required to be manufactured by an approved process, which is not specified; but more than 0.07 per cent. of sulphur or of phosphorus must not be shown on their analysis. The mechanical properties for these cast steel for railway rolling-stock are simply stated as minima (B.E.S.A. Report No. 24, Part 4—1921; Specification 10), and the same applies to cast steel for electric tramway car wheel centres (B.E.S.A. No. 150—1922).

Table VI.—*B.E.S.A. Cast Steel for Rolling-Stock.*

| Steel used for :— | Min. U.T.S. Tons/sq. in. | Min. El. Per cent. |
|---|---|---|
| Railway castings with wearing surfaces | 35 | 10 |
| Railway wheel centres and general castings | 26 | 15 |
| Electric tramway wheel centre castings | 33 | 10 |

Finally, in the more modern specification for two grades of steel castings for automobiles (B.E.S.A. No. 5,028—1924), four chemical elements are controlled, and minimum chemical properties required, as briefly indicated below):

Table VII.—*B.E.S.A. Cast Steel for Automobiles.*

| Grade. | Max. C. | Min. M. | Max. S. | Max. P. | Min. U.T.S. Tons/ sq. in. | Min. El. Per cent. |
|---|---|---|---|---|---|---|
| 1 | 0.30 | 0.40 | 0.06 | 0.05 | 26 | 20 |
| 2 | 0.30 | 0.60 | 0.08 | 0.07 | 26 | 15 |

The most popular alloy steel, so far as castings are concerned, would seem to be that invented by Sir Robert Hadfield. His *high-manganese steel*, for wear-resisting purposes, is almost too well known to require mention. It was the first of the austenitic steels to be extensively used, and its abnormal properties puzzled those accustomed to carbon steels. Usually it contains 11 to 13 per cent. of manganese and about 1.2 per cent. of carbon, and one has seen it cast into dredger buckets, rail crossings, and many other parts subject to heavy abrasive wear in service.

*Castings for ships' propellers*, and other articles of relatively small size, up to about two tons in weight, have been made in the 13 per cent. chromium, 0.35 per cent. carbon martensitic steel, called "*Stainless*," where corrosion resistance was especially desired. Its properties are: Yield point, 30 to 37 tons/sq. in.; ultimate tensile stress, 45 to 51 tons/sq. in; elongation, 20 to 27 per cent. on 2 in.; reduction in area, 35 to 50 per cent.; and bend without breaking, 180 deg.

Popular as this steel has been in the forged condition, for table knives and many other purposes, it has not proved to be amenable to regular foundry operations, and has been replaced almost entirely by castings of another *stainless steel*, which is much more resistant to sea-water corrosion, and retains its polished appearance untarnished. It contains approximately 18 per cent. of chromium and 8 per cent. of nickel.

The author has seen steels of this type, all austenitic in character, with varying percentages of nickel and chromium, melted in crucibles and cast into many small and intricate articles. Weighing-machine parts, shop fittings, taps, valves and sanitary fittings, ship, yacht, tramway and railway components, to mention but a few, are being cast in these *austenitic nickel-chromium steels*. The author has visited locally three different foundries, which have taken up the casting of these new, highly corrosion-resistant steels during the last few years.

The composition of a typical steel of this type is:—C, 0.14 to 0.16; Mn, 0.28 to 0.31; Si, 0.04 to 0.24. Cr, 17.8 to 18.0; and Ni, 8.0 to 8.3 per cent. The mechanical properties are of the order of:—Yield point, 15.1 tons/sq. in.; ultimate tensile stress, 48.6 tons/sq. in.; elongation, 50 per cent.; and Brinell hardness, 175. The thermal conductivity is 0.033 cal./sq. cm. deg. C.; the electrical resistivity 69 microhms/c.c.; and permeability, 1.01 to 1.03.

*For heat-resisting purposes*, several firms are now casting austenitic nickel-chromium steels, to which about 4 per cent. of tungsten, 2 per cent. of silicon, and, in some cases, other costly elements, such as molybdenum, vanadium or copper, are added.

Tool-steel manufacturers, though most of their products are forged, frequently cast *alloy tool steels* in sand, moulded to the shape of complicated "form" cutters, or other such tools, which would be difficult to produce as forgings.

## Book Review.

**Wrought Iron in Architecture,** by Gerald K. Geerlings. Published by Charles Scribner's Sons, 7, Beak Street, London, W.1. Price 30s.

The author in his preface quotes Mr. B. J. Fletcher, Director of the Birmingham Municipal Art School, as saying: "It is possibly true to say that of the miles of cast-iron railings which have been made during the past century none has repeated the cast-metal tradition, which died about 1840, or made beauty in any other manner from emphasis of the qualities and nature of cast iron. Most of it imitates wrought iron. It is interesting to notice in this connection that errors of treatment are most frequent and greatest in those materials which are most easily modelled or moulded." We, to be honest, must plead guilty of a recent serious artistic lapse. In reviewing another book on this subject, we stated "It must be admitted that castings are not dealt with to any extent, but a fair number are of the designs carried out in wrought iron are quite capable of being reproduced in cast iron." We feel strongly that such a beautiful book as the one under review should be in the hands of every art founder, not to copy, but to develop his artistic sense, to familiarise him with "period" characteristics and to create enthusiasm for emulation but on original lines, taking cognisance of the potentialities of his materials.

The author, an American, has that breezy, interesting way of expressing himself generally to be associated with his country of origin—"verdantique with envy" and "to press-agent its virtues" are two typical examples. The lesson of getting the best out of the material handled is splendidly dealt with by the author in his first section, and by applying his reasoning the founder will find much of real value in the production of "*objets d'art.*"

Before dealing with national art, an interesting and well-informed section is devoted to the practical carrying out of the craft. The author then deals in chronological form with the art as developed in Italy, Spain, France, Belgium and Holland, England, Germany and America.

We would specially refer readers to the "Bibliography," most entries in which are given a one-line comment indicating either its special feature or its scope. It is undoubtedly a very intelligent treatment, worthy of emulation by other writers.

The value of this type of book is very largely enhanced by the number and choice of the illustrations, and in this connection congratulations are due to both author and publisher. They number 324, slightly more than one to every page. This book, by the way, is a companion volume to "The Metal Crafts in Architecture" by the same author.

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## ILLUMINATING BIRMINGHAM DISCUSSION.

### Milled Sand should be Stored.

Following Mr. R. Spriggs' lecture to the Birmingham Section of the Institute of British Foundrymen, printed on page 409 of our last issue, an interesting discussion ensued. It was opened by Mr. Wilkinson, who in proposing a vote of thanks to the lecturer for his very practical Paper, observed that it was almost a new subject to most of them, and he appreciated the fact that Mr. Spriggs had taken a discriminating and conservative attitude as regards these mechanical installations, as it was useless installing conveyors unless they were likely to save money. Where considerable quantities of sand were used he thought belt conveyors were preferable. The Citroën foundry in Paris, for example, employed belt conveyors, and had overcome the difficulty of vibration and the consequent balling-up of the sand. Belt conveyors, properly designed, would do the work, but he imagined they were more expensive than the scraper type, which was excellent for short distances but not so efficient as belt conveyors for long distances. The method of utilising conveyors to store moulds shown by the lecturer was certainly a most economical and convenient one for foundries with a large output. As regards storage room for dry sand, he preferred storage for milled sand. He believed sand was always better for storage, and considered it better if stored after milling than before.

### Desirability of Stocking Pig-Iron.

Mr. E. J. Lewis, in seconding, remarked that most of them had recently been over the Morris Motors, Limited, foundry, photographic slides of which in respect to its handling mechanism had been largely shown in illustration of the lecture. He made some inquiries as to the output required to meet the cost of that elaborate installation, and proceeded to state that under present conditions foundries did not desire to cut their stock of pig-iron down to the minimum. With blast furnaces so often shut down they found it difficult to obtain their own particular type of pig-iron continuously. Hence they would be glad if they could stock more pig-iron than they had room for, when the opportunity arose for obtaining supplies. Some of these conveyor systems seemed to be things of beauty from the designers' point of view, but unfortunately there were not many foundries with railway facilities for shipping stuff into their works, inasmuch as they were not engaged on the production of castings on a large scale, and there was a difficulty in shipping material from the railway to their works. However, Mr. Spriggs had dealt with his subject on common-sense lines by showing how sectional conveyor plant could be adapted for certain work, and had provided them with something worth considering. Unfortunately their orders were seldom large enough in this country to warrant them laying down a conveyor plant of the extensive description shown, but he should add that handling equipment he himself had installed had proved eminently satisfactory.

### Diploma Awarded to Mr. Wood.

The vote having been carried, the President (Mr. E. H. Tyson) announced that he had a pleasing duty to perform. He then asked Dr. D. H. Wood, a former President, to accept a diploma awarded by the Committee for his excellent Paper last session on "The History of Iron Founding in the Midlands," remarking that he thought everyone who heard the lecture was satisfied that it was the best given that session. (Applause.)

Mr. Spriggs, after acknowledging the vote, said that one of the chief features of the flight conveyor was the easy and convenient way in which material was discharged into a series of hoppers. It was not nearly so easy with a belt conveyor, which did not plough so satisfactorily. (Mr. Wilkinson: The Citroën belt-system does.) Mr. Spriggs said he did not doubt that particular instance, but generally a belt conveyor was not so efficient in discharging as one pushing along a drive and letting the material drop through. At the same time, flight conveyors were rather more costly than belt conveyors. As to the storing of milled sand to let it mature and improve in quality, he wondered how much there really was in that point. (Mr. Wilkinson and other members: "Everything," and "Without question.") However, if they had large hoppers of milled sand, it had to be moved mechanically. As regards supplies of pig-iron and storage, he had met several important foundrymen who were not disposed to keep quantities in stock, and surely it ought to be possible for them to be supplied as needed. He did not quite appreciate the difficulty of a foundry not being adjacent to a railway, inasmuch as material was nowadays so frequently delivered by road transport. While elaborate plant was not required for the average foundry, it did not follow that a mould conveyor or a sand conveyor would not be advantageous and economical. As to weighing charges in the Telpher installation, if they were made up on the ground floor there should be a weighing machine incorporated in the truck equipment, or, alternatively, a weighing machine could be incorporated in the Telpher track and loads weighed while suspended from the hook of the Telpher trolley hoist.

### Skip Charging of Cupolas.

Mr. T. H. Turner asked what advantage was there in having a man operating "in the air" as shown in the slide of Sterling metals and other plant, and could the lecturer give his views on skip charging direct into the cupola as at Stanton? Here the skips were charged from the bins at the bottom and worked by an inclined hoist and tipped at the top, as in blast-furnace charging.

Mr. Spriggs mentioned that in direct charging the skip was lowered on to projecting bars for discharging into the cupola, and he had no fault to find with skip hoists. But the Telpher plant had the advantage of covering an area, the method of which he explained. A Telpher rail might be 20 ft. above ground and too high for ground operation. Hence a man was required in the cabin to exercise proper control. Replying to other questions, Mr. Spriggs said he had never used an apron conveyor for feeding sand from a hopper, and the jigging plate of which he had spoken seemed to him to be the better job. However, he gathered that the large American foundries employed the apron feed, and therefore it should be satisfactory in its working.

### Belt Conveyors need Ample Rollers.

Mr. F. J. Cook, remarking that the mechanical handling of materials in the foundry was a common-sense job, said everyone must apply it to their particular needs, as the lecturer had pointed out. In the principal plant which had been shown he thought it had been overdone. Offering some criticism of the means depicted for charging cupolas, Mr. Cook said he was a strong believer in the hand-charging method for anything up to 7 tons per hour. He did not suggest that the pig should be carried up to the stage by manual labour: that could be done mechanically. But from that point he should prefer to weigh in and charge up to that quantity per hour, and guaranteed to do it quicker than any mechanical means he had yet seen. Unless there were hoppers and the necessary plant at the cupola stage, and it would require to be a large one at that, the charging would be slow, and very often it was found that the charge was below the charge door. Regarding the skip charging which had been referred to in the discussion, he did not know of a worse method of charging the cupola than bucket tipping down an incline, because there was the real danger of all the iron going to one side and the coke on the other side. By the tilted-bucket method there was always the risk of an incline of material instead of a level horizontal bed all the way up. The best way was to use a drop-bottom bucket, and let it go straight in, by which means the charge would be distributed in layers. Otherwise with the tilted-bucket system a man was needed to level it up. Touching on belt conveyors, Mr. Cook suggested that much of the trouble with them was that they had not sufficient rollers, with the result that in covering a long distance sagging was introduced and consequent jarring and balling up. However, he had seen many successful sand conveyors of the belt type, incorporating a quite good plough-arrangement with the metal belt; and it had this advantage, that it could be deposited on the bottom of the belt and be brought back again instead of being dropped on the floor.

### Tilting Skip Charging Defended.

Mr. Spriggs, while disclaiming any pretensions to be an expert on the melting of iron, said he should have expected the drop-bottom bucket which distributed the metal round the sides of the cupola to have been taken up, but he had not found this to be so. People who charged with an ordinary tilting skip, and who apparently knew their business, were satisfied with the results, and of course he had to let it go at that. Upon inquiry as to the reason why the drop-bottom bucket was not substituted, he was invariably given the answer, "There is nothing in it." Belt conveyors with steel bands were quite good; they could return the surplus to the elevator again. But the flight conveyor, because of its simple and more efficient discharge or feed to the hoppers, was, he thought, superior to the steel band or any other type of belt conveyor, and he had come to this conclusion after painful experience. As to facing sand, the use of large quantities possibly meant a conveyor system, but in many cases the general sand was so much improved that facing sand could be done without, although in some steel foundries this would be unthinkable and impossible. But in many repetition jobs they had been able to cut out facing sand owing to this improvement.

Mr. D. H. Wood hesitated to disagree with Mr. Cook as to the tilted-skip method of charging, but said his experience was that it was very satisfactory.

Replying to another observation of Mr. Wood—who, in referring to the Telpher plant, said the charging arrangements by mono-rail were operated from a central point—Mr. Spriggs stated that there was a number of plants working on this remote control system. The drop-bottom bucket method which Mr. Cook had cited was, to his mind, the ideal one for charging cupolas, but it was only applicable to cupolas of something over 7 to 8 tons per hour capacity. It was a method which would be adopted by many foundrymen if a scheme could be devised for charging smaller cupolas, but as things were he strongly advised against it.

Mr. Cook: I quite agree.

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## Trade Talk.

The Tees-side Bridge & Engineering Works, Limited, Middlesbrough, have decided to lay down a galvanising plant.

British Brown-Boveri, Limited, have removed from Trafalgar House, Waterloo Place, to 56, Victoria Street, London, S.W.1.

The Midland Iron Company, Limited, Rotherham, is being offered for sale as a going concern by the receiver for the debenture holders.

The employees of Babcock & Wilcox, Limited, at Lincoln have contributed the sum of £248 2s. 1d. to the local hospital during the last 12 months.

Messrs. Hurst, Nelson & Company, Limited, Motherwell, have received an order from the Rhodesian Railways, Limited, to supply eight cabooses.

Messrs. John Lewis & Sons, Limited, Aberdeen, have launched the steam trawler "Loch Shin," built for the Empire Steam Fishing Company, Limited, Aberdeen.

Messrs. Barclay, Curle & Company, Limited, Whiteinch, have secured a contract for the construction of a 5,000-ton steamer for the Hain Steamship Company, Limited, Cardiff.

The Great Western Railway has allocated an order with Messrs. Guest, Keen & Nettlefolds, Limited, for 120,000 steel sleepers. The contract will be carried out at the company's works at Dowlais, Cwmbran.

The British Mannesmann Tube Works, Newport, after being closed for nine days, reopened last week, arrangements for a resumption of work having been made with the management by local officials of the Iron and Steel Trades Confederation.

New generating plant at the Barrow Corporation Electricity Works was started recently. To replace the old sets of a total capacity of 800 kw., a 7,000-kw. turbo-alternator has been installed by the Metropolitan-Vickers Electrical Company, Limited.

The directors of Tube Investments, Limited, have decided to issue 365,650 additional ordinary shares of £1 at 25s. It is stated that the rapid expansion of the company's businesses is such that more capital is required and can be profitably employed.

The Great Western Railway Company are purchasing steelwork and machinery to the value of £1,000,000, including 123,000 steel sleepers and 50,000 tons of rails which will be required for laying 51 miles of track to be completed within the next 12 months.

Messrs. Scotts' Shipbuilding & Engineering Company, Limited, Greenock, have launched the single-screw cargo steamer "Dalcross," built for the United Steam Navigation Company, Limited, London. The vessel is 8,450 tons deadweight on a draft of 24 ft. The propelling machinery is being supplied by the builders.

The Clyde District Committee of the United Patternmakers' Society have agreed to withdraw the embargo on overtime which they imposed on September 30. The withdrawal took effect from December 4. The embargo was decided upon as a protest against the refusal of the employers to grant an increase of 4½d. per hour.

The end of the first big constructional programme undertaken by Imperial Chemical Industries, Limited, at their works at Billingham-on-Tees is now almost in sight. The last unit of nitrogen fixation plant has entered upon the productive stage, and the production of ammonium sulphate has increased to about 2,000 tons daily.

After careful examination of the different systems of ship propulsion, the Lloyd Sabaudo Company, one of the largest of the Italian shipowning firms, have decided to adopt high-pressure steam in conjunction with Yarrow boilers for a large liner which is being constructed for them by the Stablimento Tecnico Triestino, of Trieste. The full working designs of the boilers are being prepared by Messrs. Yarrow & Company, Limited, Scotstoun, Glasgow.

Messrs. David & William Henderson, Limited, Glasgow, have launched the cargo steamer "Dudley Rose," which they have built for Messrs. Richard Hughes & Company, Liverpool. The vessel is 250 ft. in length and of about 1,600 tons gross. She is of the single-deck type, with quarter, bridge and forecastle decks. The propelling machinery is being supplied by the builders, and consists of triple-expansion engines having steam supplied from two natural-draft single-ended boilers working at 180-lb. pressure.

Mr. H. G. Gilchrist, of Messrs. Halley Motors, Limited, Yoker, presided at the first of a series of four lectures, under the auspices of the London lectureship, by Mr. Kenneth M. Sloan, in the Engineering Department of Glasgow University. The subject was "Workshop Inefficiencies and Suggested Remedies." Mr. Sloan, in the course of the lecture, discussed in detail the inefficiencies met with in connection with various functions involved in a manufacturing establishment. The unreasonable demands made upon the average foreman and the consequent inefficiencies were dealt with, and were illustrated by examples from practical experience.

Messrs. William Denny Brothers, Limited, Dumbarton, have received an order from the L.M. & S. Railway Company to build a vessel for the Clyde passenger service. The vessel will be of novel design, and embody several special features which, it is hoped, will prove popular with the travelling public. A second order has been received from the Southern Railway Company to build another motor ferry steamer for service between Portsmouth and the Isle of Wight. The vessel is the third of the type which the Southern Company are putting on the route between Portsmouth and Fishbourne owing to the increased demand for the carriage of motor-cars between the mainland and the island.

Messrs. Mirrlees, Watson Company, Limited, Glasgow, recently supplied two 10-in. five-stage borehole pumps for the Mid-Kent Water Company's Trosley pumping station, each having a capacity of 75,000 galls. per hr. at 207 ft. head. They have now received a further order from the same company for their Charing pumping station. The duty of this pump will be 26,400 to 38,400 galls. of water per hr. against heads of 464 and 412 ft. respectively. The pump will be driven through double-helical gearing by a Mirrlees, Bickerton & Day three-cylinder Diesel engine of a normal rating of 135 b.h.p.; speed of the engine, 230 r.p.m.; and of the pump, 900 r.p.m. The pump will have three lower and five upper stages. The water will be delivered from the lower stages through a series of sand filters, passing thence to the suction of the upper stages, whence it will be delivered to the reservoir.

Sheffield Chamber of Commerce has protested against criticism which, it says, is frequently to the commercial detriment of the country. Such unfortunate statements as are made from time to time by responsible officials and politicians do untold harm abroad. Mr. Snowden's speech at the recent Cutlers' Feast is cited as a case in point. The Chamber says it may be true in some cases that certain sections of our industries are not so up to date as they ought to be, but, on the other hand, it must be borne in mind that British industries have been paying the heaviest taxation in the world, they are supporting some of the most highly-paid labour, and they are employing some million people more than in the years prior to the war. Is it to be expected that at the same time and in every case they can find the money and the means to introduce all the new plant and new methods which Mr. Snowden alleges are long overdue?

## Contracts Open.

**Johannesburg,** January 9.—Two 10-ton travelling cranes, for the South African Railways and Harbours. The Department of Overseas Trade. (Reference A.X. 8,833.)

**Kelvedon, etc., Essex,** December 10.—Centrifugal pumping plant, for the Braintree Rural District Council. Mr. J. D. Haworth, 3, Central Buildings, Westminster, S.W.1. (Fee £5, returnable.)

**Santiago,** January 20.—Locomotive and rolling-stock parts, for the Chilean State Railways Administration. The Department of Overseas Trade. (Reference C. 3,159.)

**Stone, Staffs,** December 14.—Sewage sludge pumps, etc., for the Urban District Council. Mr. W. W. R. Harlow, surveyor, Town Hall, Stone.

**Indian Output of Bauxite.**—There was a large increase in the total Indian production of bauxite in 1928; it rising from 4,310 tons in 1927 to 14,667 tons. Of this total, 11,167 tons were produced in the Kaira district of Bombay and 3,500 tons in the Jubbulpore district of the Central Provinces. British Guiana is now the largest producer in the British Empire, but is still far below France.

## Personal.

Employees of Argus Foundry, Limited, Thornliebank, Glasgow, have subscribed the sum of £87 3s. to infirmaries, etc., in the West of Scotland.

The employees of Messrs. McDowall, Steven & Company, Limited, Laurieston Foundry, Falkirk, held their annual social reunion and whist drive in Falkirk on December 6.

Mr. Roger Newberry, former manager of the foreign department of the Bucyrus-Erie Company, South Milwaukee, America, has been appointed sales-director of the English associate company, Ruston-Bucyrus, Limited.

The general manager of Messrs. David Colville & Sons, Limited, Motherwell, Mr. G. P. West, although retaining his seat on the board of directors, is relinquishing the managerial duties at the end of the year. Dr. Andrew M'Cance has been invited to join the board of directors of the company as from January 1, 1930. Dr. M'Cance is a metallurgist of world-wide reputation, and he has acted as principal consulting metallurgist to Messrs. David Colville & Sons, Limited, for a good many years, besides controlling as managing director the allied firm of the Clyde Alloy Steel Company, Limited, Motherwell, which specialises in the production of high-grade castings, motor and tool steels, stainless iron, steel, etc.

### Wills.

| | |
|---|---|
| Webb, J. S., ironfounder, of Tottington | £12,148 |
| Lawley, Alderman W. (the elder), director of W. & J. Lawley, Limited, brass and iron founders, Britannia Foundry, West Bromwich, S. Staffs | £32,415 |

## Obituary.

Mr. Charles Armstrong, foreman patternmaker with Messrs. William Beardmore & Company, Limited, Dalmuir, died at his home in Old Kilpatrick on December 5.

Mr. George Strachan, managing director of the Fairfield Shipbuilding & Engineering Company, Limited, Govan, Glasgow, died on December 3 at his home in Pollokshields.

Mr. Alexander Bruce Weir, for many years with the Saracen Foundry Company, Limited (Walter Macfarlane & Company, Possilpark, Glasgow), has died at his home in Milngavie.

The death has occurred at the Royal Infirmary, Aberdeen, of Mr. John Gordon, who for many years has been in charge of the moulding shop of Messrs. Hall, Russell & Company, Limited, Aberdeen.

## Reports and Dividends.

**Yarrow & Company, Limited.**—Net profit, £3,320; brought in, £4,154; carried forward, £7,474.

**Whitehead Iron & Steel Company, Limited.**—Interim dividend on the ordinary shares at the rate of 10 per cent. per annum.

**Dorman, Long & Company, Limited.**—Profit, £391,400; brought in, £4,622; transferred from provision for liabilities to the Government, £454,582; debenture interest, £225,237; preference dividend, £31,083; provision for redemption of 5½ per cent. debenture stock, £40,463; depreciation, £320,000; written off investments, £70,000; written off stocks, £44,000; reserve for bad and doubtful debts, £20,000; carried forward, £97,820.

## New Companies.

**Ruston-Bucyrus, Limited.**—Capital £800,000 in £1 shares. Manufacturers of excavating machinery, etc. Directors: W. W. Coleman, Colonel P. D. Inides, R. W. Newberry, Sir Archibald J. C. Ross, Colonel J. S. Ruston, G. R. Sharpley, J. H. W. Rawlyn and V. W. Bone.

**Lindley Duffield & Company (Metallurgical & Finance), Limited,** Imperial House, Kingsway, London, W.C.2.—Capital £100,000 in £1 shares, to carry on exploitation business, to acquire, build, or control iron, steel and engineering works, etc., and to adopt an agreement with Lindley Duffield & Company, Limited. Directors: F. Lindley Duffield and the Rt. Hon. Lord Aberdare (chairman).

**South African Iron and Steel Institute.**—There is a proposal to form a South African Iron and Steel Institute. According to a Johannesburg paper just to hand the first and main object of the new organisation would be to find markets for iron and steel.

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AND AT MANSFIELD, WARSOP, EBBERSTON, CORBRIDGE, BRAMCOTE, LUFFENHAM, TOW LAW, MONTGREENAN &c.&c.

LONDON OFFICE 20 Budge Row E.C.4. (M° A.C. Turner)
Head Office Wicker Arches, SHEFFIELD
GLASGOW OFFICE 82 Dale St. C.5 (M° A.W. Montgomery)

# ZENITH SAND!

**A BEAUTIFUL EVEN-GRAINED WELL-BONDED FREE-VENTING SAND**

**FOR IRONMOULDING**
**IN TWO GRADES —— MEDIUM & SUPERFINE.**

*Having, through our subsidiary Company, Coolee Ltd., the proprietors of the famous Bramcote Sand Quarries, purchased from Messrs. John Williams (Birmingham Sand Ltd.) the freehold sand quarries at Aggborough, Kidderminster, together with the plant and machinery with which they are equipped, we are now in an excellent position to supply our customers in all parts of the country, but particularly in*

**SOUTH WALES, THE BLACK COUNTRY, THE WEST OF ENGLAND, THE BIRMINGHAM DISTRICT, &c.,**

*with these excellent red sands, with promptitude and regularity, and at a reasonable price for either grade.*

**ENQUIRIES INVITED —— SAMPLE BAGS FREE**
**QUOTATIONS ON APPLICATION.**

**EVERY DAY SEES**
**BETTER AND BETTER SERVICE FROM GENEFRAX HOUSE!**

# Iron and Steel Markets.

## Pig-Iron.

**MIDDLESBROUGH.**—The apathy prevailing of late in the Cleveland iron market gives few signs of an early recovery to more active conditions, and for the brief remainder of the year now closing it may be regarded as highly improbable to expect an improvement in the existing position of the Tees-side industry. Makers, however, seem quite reconciled to accept the present situation in a philosophic mood, arguing, from their own standpoint, that current outputs are going regularly into consumption to meet home requirements, and that current quotations suffice to cover costs of production, although with only a slender margin of profit. In the meantime, inflation of prices, even though it be justified by the increased cost of production, has brought undoubted evils in its train. It has killed the export trade in Cleveland iron. Sales abroad have become almost impossible to negotiate, simply because consumers can get cheaper iron elsewhere, and even in Scotland Continental iron is now proving a serious competitor with Cleveland and the Midlands. The result is that shipments for November only totalled 21,518 tons, or 4,000 tons below the figure for October. Quotations again remain stationary, both makers and merchants adhering to a minimum figure of 72s. 6d. per ton for the standard No. 3 Cleveland G.M.B. quality. For No. 1 foundry iron 75s. per ton is quoted, for No. 4 foundry iron 71s. 6d., and for No. 4 forge 71s. per ton.

In the market for East-Coast hematite the advancing tendency of prices continues with steady persistence, and mixed numbers are now within sight of attaining the maximum of 80s. per ton, the figure which for months past has been the declared aim of makers. For the present, however, it is still possible to buy iron at 79s. per ton. But that is only for December delivery, and, if it be possible, it appears to be the intention of the ironmasters that, when their new contracts for raw material become operative at the beginning of January, 80s. per ton shall be the market price. On the North-West Coast Bessemer mixed numbers are still quoted 77s. per ton at works.

**LANCASHIRE.**—Business in the local pig-iron markets, considering the time of year, continues fairly active, deliveries showing a satisfactory average for the season, and buying on forward account quite encouraging to furnace owners. With regard to the future, there is still a fairly confident feeling being expressed in market circles that about the second half of January will witness a definite improvement in buying interest. Stabilised quotations remain firm, with Staffordshire and Derbyshire No. 3 brands at 77s. per ton, including delivery in the Manchester price zone. There is only a quiet buying movement in the case of Scottish iron, though prices are well held at up to 93s. 6d. per ton delivered.

**THE MIDLANDS.**—With the end of the year in sight, local markets for foundry pig are practically featureless, the majority of consumers postponing forward buying until the prospects of future trade possibilities become more clearly defined. Prices, however, continue firm at the fixed zone levels, the quotations ruling as follow:—No. 3 Derbyshire, 78s. 6d.; No. 3 Northants, 75s.; North Staffordshire, 79s. 6d.; and Scottish brands, 95s., all per ton delivered local stations.

**SCOTLAND.**—Consumers in this area are already beginning to restrict supplies of pig-iron in view of the approaching holidays, as they will want to get their stocks down to as low a point as possible. In spite of this, makers report that deliveries are fair. What is causing them anxiety is the price obtainable for their iron. This remains unchanged on the basis of 76s. per ton f.o.t. furnaces for No. 3 Scotch foundry.

## Finished Iron.

At Birmingham this week only a moderate demand for this class of material was in evidence, conditions generally being decidedly dull and disappointing in this respect. Prices continue to vary considerably, and anything from £10 to £10 10s. is quoted for crown bars. A satisfactory crown iron can be obtained from the Staffordshire makers at £10 5s. The figure for nut and bolt bars is between £9 and £9 7s. 6d., but the bulk of the business now being placed by local consumers is going to the Continental mills. Staffordshire marked bars are quoted at £12 10s. at works, and good business is being placed, particularly from the wagon works.

## Steel.

At Sheffield this week the market for steel and semi-products has been moderately active, but Continental competition is hampering the demand for basic billets and wire rods. For Siemens acid billets there has been a slight revival of the demand, but it does not amount to much. Prices:—Basic billets, soft, £7; semi-hard, £7 12s. 6d.; medium, £8 2s. 6d.; hard, £9 2s. 6d. to £9 12s. 6d.; Siemens acid billets, £9 10s.; basic wire rods, soft, £8 2s. 6d.; medium, £9 15s. to £10; hard, £10 10s. to £11; acid billets, £12 5s. to £12 10s.; steel hoops, £9 15s. to £10. The market for tinplates continues fairly active, with prices firmly quoted 18s. 9d. to 18s. 10½d. basis for coke quality, net cash, f.o.b. Welsh ports.

## Scrap.

The abstention of buyers from the various markets for foundry scrap material, and possibly, too, the perceptible slackening of industrial activity, has had the effect of weakening prices all round. On Tees-side, with the foundries requiring only smaller quantities, heavy cast iron has had a further relapse, ordinary quality being now on offer at 62s. 6d., though 66s. 6d. or thereabouts is quoted for good machinery quality in handy sizes. In Scotland, the cast-iron scrap market is still quiet, and machinery quality is difficult to dispose of at around 67s. 6d. to 70s., with ordinary cast iron, suitable for foundries, at 64s. to 65s. Cast-iron chairs are making about 67s. 6d. to 70s., and light cast-iron scrap at 60s., with light metal and firebars at 57s. 6d. The above prices are all per ton delivered f.o.t. consumers' works.

## Metals.

**Copper.**—Viewed as a whole, the outlook for base metals can hardly be regarded as satisfactory, and in the case of warrant copper fluctuations of values incline distinctly to lower levels, without present indications of early recovery. Although it is claimed on the one hand that producers will have no difficulty in maintaining prices at about the present level, it is asserted on the other that stocks in some quarters are becoming heavy, and it is pointed out that the demand at home and abroad shows little sign of expansion.

Closing quotations are :—

*Cash.*—Thursday, £68 15s. to £68 17s. 6d.; Friday, £68 5s. to £68 7s. 6d.; Monday, £68 12s. 6d. to £68 15s.; Tuesday, £68 15s. to £68 17s. 6d.; Wednesday, £68 12s. 6d. to £68 15s.

*Three Months.*—Thursday, £68 12s. 6d. to £68 15s.; Friday, £68 to £68 2s. 6d.; Monday, £68 8s. 9d. to £68 10s.; Tuesday, £68 5s. to £68 7s. 6d.; Wednesday, £68 2s. 6d. to £68 5s.

**Tin.**—Following a temporary recovery last week, values of standard tin relapsed again to new low records for the past seven years, touching £173 for cash. Market pessimism, however, is hardly endorsed by the latest statistics. The visible supply for November was lower, as was the carry-over in Malaya, and yet this contraction of about 1,000 tons failed to bring forward any support for the market.

Official closing prices :—

*Cash.*—Thursday, £174 to £174 2s. 6d.; Friday, £173 5s. to £173 10s.; Monday, £177 10s. to £177 15s.; Tuesday, £181 to £181 5s.; Wednesday, £179 15s. to £179 17s. 6d.

*Three Months.* — Thursday, £177 5s. to £177 7s. 6d.; Friday, £176 10s. to £176 12s. 6d.; Monday, £180 15s. to £181; Tuesday, £184 5s. to £184 7s. 6d.; Wednesday, £182 15s. to £183.

**Spelter.**—The spelter market remains dull and inactive. The demand shows no sign of improvement, and producers have difficulty in effecting sales, even at the current level of prices.

Daily quotations are :—

*Ordinary.*—Thursday, £20 7s. 6d.; Friday, £20 2s 6d.; Monday, £20 6s. 3d.; Tuesday, £20 3s. 9d.; Wednesday, £20 2s. 6d.

**Lead.**—The market for soft foreign pig has failed to present any feature of interest. Prices have remained very steady, but the tendncy, if anything, is towards renwed weakness, probably in sympathy with the other base metal markets.

The week's prices have been :—

*Soft Foreign (Prompt).*—Thursday, £21 10s.; Friday, £21 10s.; Monday, £21 10s.; Tuesday, £21 10s.; Wednesday, £21 7s. 6d.

## Industrial Newspapers, Limited.

### Value of the Trade Press.

At the annual meeting on Tuesday of Industrial Newspapers, Limited, the chairman, SIR ROBERT DONALD, G.B.E., LL.D., said he wished to refer at the outset to the changes in the constitution of the board. On September 10 last, practically the whole of the second preference and ordinary shares of the company were acquired, on terms based upon current values, by a company with which he (Sir Robert) was associated. These terms were considered satisfactory as an investment. As was usual in a purchase in such circumstances, certain alterations in the administrative control had been made by mutual agreement. He wished to record his sincere appreciation of the cordial spirit which had prevailed on all sides during these rearrangements, and to thank Sir Arthur Lowes Dickinson and his colleagues who were retiring for their help and collaboration during the transition period.

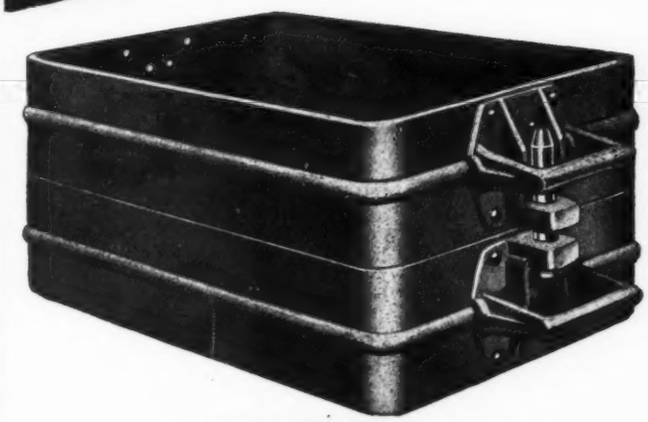
Turning to the accounts, the chairman said that the decrease in the net profit, he was glad to say, was not brought about by any serious diminution in the profit-earning capacity of the company. In spite of continued depression in the basic industries, with which their chief publications were identified, there were signs of improvement, and their gross income so far for the current year was substantially higher than for the corresponding period of last year. The chief differences between the present account and the last were in the reduction of the principal figure on the asset side, consequent upon the sale of the Manchester papers, and a substantial improvement in the company's liquid position.

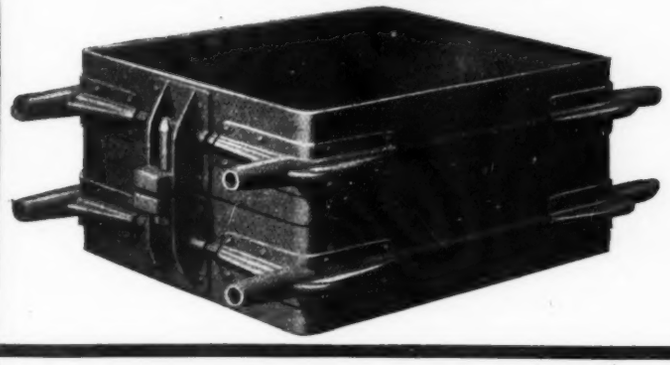
The chairman went on to deal with the question of trade papers generally. In the course of his remarks, he said that the connection between trade papers and commercial progress which had been established in the United States and Canada had not received the same support in this country. Manufacturers and business men were slow to realise that trade papers were essential factors in completing a sales organisation. There was an object lesson both to conductors of trade journals, to manufacturers and merchants, in what had been achieved by the trade and technical Press in the United States and Canada, where it had attained its highest development. It was the duty of a trade paper to serve the commercial community, to give industry a lead, to inspire as well as to inform and educate. The recognition which trade papers in the United States had won from the manufacturers and the Government as the result of carrying out this policy testified to the service which they rendered to commerce. It was during President Hoover's tenure of office as Secretary of Commerce that the United States made its greatest progress in industrial development at home, and in the advance of its export trade.

Continuing, Sir Robert said that Mr. Hoover regarded the editors of trade papers as scouts for his Department, men who had no sectional interest to serve, but who could give him unprejudiced information on tendencies in American industry and on opportunities for expansion. He held weekly conferences with them. As President, Mr. Hoover still kept in close contact with the business newspaper men, and held a monthly conference at White House. In his present drive, when he had mobilised the ablest business brains in the country to grapple with a supreme national emergency, President Hoover had met the directors of the trade Press in conference and taken them into his confidence. The example of President Hoover should not be lost on Mr. William Graham, President of the Board of Trade, or even the Prime Minister himself. While our trade papers had not the same unified business organisation behind them, yet the leading exponents of national industrial interests would be able to give Mr. Graham information and views on current problems which he could not obtain from any other source. The new directors of Industrial Newspapers, Limited, are Sir Robert Donald (chairman) and Mr. L. T. Newell.

# Sterling

## SOLID RIBBED ROLLED STEEL MOULDING BOXES





**In every class of Foundry and in every Moulding Box service Sterling Rolled Steel Boxes soon show their marked superiority, not only in the better quality of work produced, but also in increased output per man per hour.**

**Cast iron Moulding Boxes, however well made, are liable to be cracked or broken at any moment. They are also excessively heavy. Heavy boxes slow down production, reduce the capacity of your foundry, and impose unnecessary fatigue on your moulders.**

**Boxes made from sheet metal are too flimsy to stand up to the heavy duties of general foundry service.**

**View the position from any angle, there is only one solution to your moulding box problems . . . the Sterling Rolled Steel Box, with the solid centre reinforcing rib and the two stiff sand-retaining ledges. They are light, easily handled, strong, rigid and durable. Cannot crack or break. Cannot distort or get out of truth. They are accurately made and guaranteed interchangeable.**

**Write at once for Catalogue No. 37, which shows some thirty different standard styles of boxes.**

## STERLING FOUNDRY SPECIALTIES LTD.

*London Office :*
13, VICTORIA STREET, S.W.1.

**BEDFORD.**

*Telephone :* 3345 BEDFORD.
*Telegrams :* "STERFLASK, BEDFORD."
*Code :* WESTERN UNION.

# WEEKLY PRICE CURRENT.

## COPPER.

| | £ | s. | d. |
|---|---|---|---|
| Standard cash | 68 | 12 | 6 |
| Three months | 68 | 2 | 6 |
| Electrolytic | 82 | 0 | 0 |
| Tough | 75 | 5 | 0 |
| Best selected | 75 | 15 | 0 |
| Sheets | 110 | 0 | 0 |
| India | 90 | 10 | 0 |
| Wire bars | 84 | 0 | 0 |
| Do. Dec. | 84 | 0 | 0 |
| Do. Jan. | 84 | 0 | 0 |
| Ingot bars | 84 | 0 | 0 |
| H.C. wire rods | 85 | 16 | 3 |
| Off. av. cash, November | 69 | 8 | 4 5/16 |
| Do., 3 mths., November | 68 | 19 | 3 1/16 |
| Do., Sttlmnt., November | 69 | 8 | 5 5/16 |
| Do., Electro, November | 82 | 19 | 9½ |
| Do., B.S., November | 75 | 16 | 11¼ |
| Do., wire bars, November | 83 | 15 | 5½ |
| Aver.spot price,copper, Nov. | 69 | 8 | 4 5/16 |

Solid drawn tubes 15d.
Brazed tubes 15d.
Wire 11¼d.

## BRASS.

Solid drawn tubes 12¾d.
Brazed tubes 14½d.
Rods, drawn 12¼d.
Rods, extd. or rlld. 8d.
Sheets to 10 w.g. 11¼d.
Wire 10½d.
Rolled metal 10½d.
Yellow metal rods 8d.
Do. 4 × 4 Squares 8½d.
Do. 4 × 3 Sheets 9d.

## TIN.

| | | | |
|---|---|---|---|
| Standard cash | 179 | 15 | 0 |
| Three months | 182 | 15 | 0 |
| English | 181 | 5 | 0 |
| Bars | 184 | 0 | 0 |
| Straits | 184 | 10 | 0 |
| Australian | 183 | 10 | 0 |
| Eastern | 184 | 2 | 6 |
| Banca | 192 | 0 | 0 |
| Off. av. cash, November | 180 | 13 | 7½ |
| Do., 3 mths, November | 183 | 12 | 10½ |
| Do., Sttlmt., November | 180 | 13 | 9½ |
| Aver. spot, November | 180 | 13 | 7⅞ |

## SPELTER.

| | | | |
|---|---|---|---|
| Ordinary | 20 | 2 | 6 |
| Remelted | 19 | 0 | 0 |
| Hard | 17 | 10 | 0 |
| Electro 99 9 | 22 | 10 | 0 |
| English | 20 | 10 | 0 |
| India | 18 | 10 | 0 |
| Zinc dust (Nom.) | 31 | 10 | 0 |
| Zinc ashes | 6 | 10 | 0 |
| Off. aver., November | 21 | 2 | 0½ |
| Aver., spot, November | 20 | 17 | 0½ |

## LEAD.

| | | | |
|---|---|---|---|
| Soft foreign ppt. | 21 | 7 | 6 |
| English | 22 | 15 | 0 |
| Off. average, November | 21 | 12 | 7 1/16 |
| Average spot, November | 21 | 12 | 5 7/16 |

## ZINC SHEETS, &c.

| | | | |
|---|---|---|---|
| Zinc sheets, English | 30 | 0 | 0 |
| Do. V.M. ex-whf. | 28 | 5 | 0 |
| Rods | 33 | 0 | 0 |
| Boiler plates | 26 | 10 | 0 |
| Battery plates | 27 | 0 | 0 |

## ANTIMONY.

| | | | |
|---|---|---|---|
| Special brands, Eng. | 48 | 15 | 0 |
| Chinese | 31 | 0 | 0 |
| Crude | 20 | 0 | 0 |

## QUICKSILVER.

Quicksilver 22 17 6

## FERRO-ALLOYS AND STEEL-MAKING METALS.

| | | | |
|---|---|---|---|
| Ferro-silicon— | | | |
| 25% | 7 | 17 | 6 |
| 45/50% | 11 | 10 | 0 |
| 75% | 19 | 0 | 0 |

Ferro-vanadium—
35/50% 12/10 lb. Va.
Ferro-molybdenum—
70/75% c. free 4/2 lb. Mo.
Ferro-titanium—
23/25% carbonless 1/- lb.
Ferro-phosphorus, 20/25% £16 0 0
Ferro-tungsten—
80/85%, c. fr. 3/1½ lb.
Tungsten metal powder—
98/99% 3/4½ lb.
Ferro-chrome—
2/4% car. £30 10 0
4/6% car. £23 2 6
6/8% car. £22 0 0
8/10% car. £21 15 0
Ferro-chrome—
Max. 2% car. £33 10 0
Max. 1% car. £39 0 0
Max. 0.70% car. £41 0 0
70%, carbonless 11d. lb.
Nickel—99% cubes, or pellets £175 0 0
Ferro-cobalt 9/6 lb.
Aluminium 98/99% £95 0 0
Metallic chromium—
96/98% 2/7 lb.
Ferro-manganese (net)—
76/80% loose £12 10 0
76/80% packed £13 10 0
76/80%, export £13 0 0
Metallic manganese—
94/96%, carbonless 1/4 lb.
Per ton unless otherwise stated.

## HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten £0 2 0
Finished bars, 18% tungsten £0 2 9
Per lb. net, d/d buyers' works.
Extras—
Rounds and squares, 3 in. and over 4d. lb.
Rounds and squares, under ½ in. to ¼ in. 3d. lb.
Do., under ¼ in. to 5/16 in. 1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in. 3d. lb.
Do., under ½ in. × ¼ in. 1/- lb.
Bevels of approved sizes and sections 6d. lb.
Bars cut to length, 10% extra.

## SCRAP.

| South Wales— | £ | s. | d. | £ | s. | d. |
|---|---|---|---|---|---|---|
| Heavy steel | 3 | 7 | 6 to | 3 | 10 | 0 |
| Bundled steel and shrngs. | 3 | 5 | 0 to | 3 | 7 | 6 |
| Mixed iron and steel | | | | 3 | 5 | 0 |
| Heavy cast iron | | | | 3 | 0 | 0 |
| Good machinery for foundries | | | | 3 | 2 | 6 |

| Cleveland— | | | | | | |
|---|---|---|---|---|---|---|
| Heavy steel | | | | 3 | 3 | 6 |
| Steel turnings | | | | 2 | 16 | 6 |
| Cast-iron borings | | | | 2 | 13 | 0 |
| Heavy forge | | | | 3 | 15 | 0 |
| W.I. piling scrap | | | | 3 | 10 | 0 |
| Cast-iron scrap | 3 | 2 | 6 to | 3 | 6 | 6 |

| Midlands— | | | | | | |
|---|---|---|---|---|---|---|
| Ord. cast-iron scrap | | | | 3 | 5 | 0 |
| Heavy wrought | | | | 4 | 0 | 0 |
| Steel turnings | 2 | 7 | 6 to | 2 | 10 | 0 |

| Scotland— | | | | | | |
|---|---|---|---|---|---|---|
| Heavy steel | | | | 3 | 10 | 6 |
| Cast-iron borings | | | | 2 | 13 | 0 |
| Wrought-iron piling | | | | 3 | 19 | 0 |
| Heavy machinery | | | | 3 | 9 | 0 |

London—Merchants' buying prices delivered yard.

| | | | |
|---|---|---|---|
| Copper (clean) | 61 | 0 | 0 |
| Brass | 42 | 10 | 0 |
| Lead (less usual draft) | 19 | 0 | 0 |
| Tea lead | 15 | 0 | 0 |
| Zinc | 14 | 0 | 0 |
| New aluminium cuttings | 65 | 0 | 0 |
| Braziery copper | 55 | 0 | 0 |
| Gunmetal | 54 | 0 | 0 |
| Hollow pewter | 132 | 0 | 0 |
| Shaped black pewter | 98 | 0 | 0 |

## PIG-IRON.

*(f.o.t. unless otherwise stated.)*

| N.E. Coast— | |
|---|---|
| Foundry No. 1 | 75/- |
| Foundry No. 3 | 72/6 |
| Foundry No. 4 | 71/6 |
| Forge No. 4 | 71/- |
| Hematite No. 1 | 79/6 |
| Hematite M/Nos. | 79/- |

| N.W. Coast— | |
|---|---|
| Hem. M/Nos. d/d Glas. | 86/- |
| ,, d/d Birm. | 93/6 |

| Midlands— | |
|---|---|
| Staffs. common* | — |
| ,, No. 4 forge* | 75/6 |
| ,, No. 3 fdry.* | 79/6 |
| Shrops. basic | — |
| ,, Cold blast, ord. | — |
| ,, ,, roll iron | — |
| Northants forge* | 71/- |
| ,, fdry. No. 3* | 75/- |
| Derbyshire forge* | 74/6 |
| ,, fdry. No. 3* | 78/6 |
| ,, basic* | — |

*d/d Black Country dist.

| Scotland— | |
|---|---|
| Foundry No. 1 | 78/6 |
| ,, No. 3 | 76/- |
| Hem. M/Nos. | 80/- |

| Sheffield (d/d district)— | |
|---|---|
| Derby forge | 69/6 |
| ,, fdry. No. 3 | 73/6 |
| Lincs. forge. | 72/- |
| ,, fdry No. 3 | 76/- |
| E.C. hematite | 87/6 |
| W.C. hematite | 89/6 |

| Lincs. (at furnaces)— | |
|---|---|
| Forge No. 4 | — |
| Foundry No. 3 | — |
| Basic | — |

| Lancashire (d/d eq. Man.)— | |
|---|---|
| Derby forge | — |
| ,, fdry. No. 3 | 77/- |
| Northants foundry No. 3 | — |
| Dalzell, No. 3 (special) | 105/- to 107/6 |
| Summerlee, No. 3 | 93/- |
| Glengarnock, No. 3 | — |
| Gartsherrie, No. 3 | 93/- |
| Monkland, No. 3 | 93/- |
| Shotts, No. 3 | 93/- |

## FINISHED IRON AND STEEL.

*Usual District deliveries for iron; delivered consumers' station for steel.*

| Iron— | £ | s. | d. | £ | s. | d. |
|---|---|---|---|---|---|---|
| Bars (cr.) nom. | | | | 10 | 15 | 0 |
| Nut and bolt iron | 9 | 0 | 0 to | 9 | 7 | 6 |
| Hoops | | | | 11 | 0 | 0 |
| Marked bars (Staffs) f.o.t. | | | | 12 | 10 | 0 |
| Gas strip | | | | 11 | 0 | 0 |
| Bolts and nuts, ¾ in. × 4 in. | | | | 15 | 5 | 0 |

| Steel— | | | | | | |
|---|---|---|---|---|---|---|
| Ship plates | 8 | 12 | 6 to | 8 | 17 | 6 |
| Boiler plts. | 9 | 12 | 6 to | 10 | 10 | 0 |
| Chequer plts. | | | | 10 | 12 | 6 |
| Angles | | | | 8 | 2 | 6 |
| Tees | | | | 9 | 2 | 6 |
| Joists | | | | 8 | 2 | 6 |
| Rounds and squares, 3 in. to 5½ in. | | | | 9 | 2 | 6 |
| Rounds under 3 in. to ¾ in. (Untested) | | | | 8 | 2 | 6 |

and upwards

| | | | |
|---|---|---|---|
| Flats—8 in. wide and over | 8 | 7 | 6 |
| ,, under 8 in. and over 5 in. | 8 | 12 | 6 |
| Rails, heavy | 8 | 10 | 0 |
| Fishplates | 12 | 10 | 0 |
| Hoops (Staffs) | 9 | 15 | 0 |
| Black sheets, 24 g. | 10 | 0 0 to | 10 5 0 |
| Galv.cor.shts., 24g. | 12 | 12 6 to | 13 0 0 |
| Galv. fencing wire, 8g. plain | 12 | 0 | 0 |
| Billets, soft | 6 | 2 6 to | 6 12 6 |
| Billets, hard | 7 | 10 0 to | 8 0 0 |
| Sheet bars | 6 | 0 0 to | 6 5 0 |
| Tin bars | 6 | 0 0 to | 6 5 0 |

## PHOSPHOR BRONZE.

| | Per lb. basis. |
|---|---|
| Strip | 1/4 |
| Sheet to 10 w.g. | 1/5 |
| Wire | 1/6 |
| Rods | 1/5 |
| Tubes | 1/9¼ |
| Castings | 1/4 |

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

## NICKEL SILVER, &c.

| | per lb. |
|---|---|
| Ingots for raising | 10d. to 1/4 |
| Rolled— | |
| To 9 in. wide | 1/4 to 1/10 |
| To 12 in. wide | 1/4½ to 1/10½ |
| To 15 in. wide | 1/4½ to 1/10½ |
| To 18 in. wide | 1/5 to 1/11 |
| To 21 in. wide | 1/5½ to 1/11½ |
| To 25 in. wide | 1/6 to 2/- |
| Ingots for spoons and forks | 10d. to 1/6½ |
| Ingots rolled to spoon size | 1/1 to 1/9½ |
| Wire round— | |
| 3/0 to 10 G. | 1/7½ to 2/2½ |

with extras according to gauge.

## AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

| | Dols. |
|---|---|
| No. 2X foundry, Phila. | 21.26 |
| No. 2 foundry, Valley | 18 50 |
| No. 2 foundry, Birm. | 14.50 |
| Basic | 20.26 |
| Bessemer | 20.76 |
| Malleable | 20.76 |
| Grey forge | 19.76 |
| Ferro-mang. 80% d/d | 105.00 |
| O.-h. rails, h'y at mill | 43.00 |
| Bessemer billets | 35.00 |
| O.-h. billets | 35.00 |
| O.-h. sheet bars | 35.00 |
| Wire rods | 40.00 |
| | Cents. |
| Iron bars, Phila. | 2.12 |
| Steel bars | 1.90 |
| Tank plates | 1.90 |
| Beams, etc. | 1.90 |
| Skelp, grooved steel | 1.85 |
| Skelp, sheared steel | 1.85 |
| Steel hoops | 2.20 |
| Sheets, black, No. 24 | 2.75 |
| Sheets, galv., No. 24 | 3.40 |
| Sheets, blue an'l'd, No. 13 | 2.25 |
| Wire nails | 2.40 |
| Plain wire | 2.40 |
| Barbed wire, galv. | 3.05 |
| Tinplates, 100-lb. box | $5.35 |

## COKE (at ovens).

| | |
|---|---|
| Welsh foundry | 32/6 to 35/- |
| ,, furnace | 27/6 to 32/6 |
| Durham and Northumberland— | |
| ,, foundry | 22/6 |
| ,, furnace | 20/6 |
| Midlands, foundry | — |
| ,, furnace | 21/6 and up |

## TINPLATES.

f.o.b. Bristol Channel ports.

| | | | |
|---|---|---|---|
| I.C. cokes | 20×14 box | | 18/9 |
| ,, | 28×20 ,, | | 38/- |
| ,, | 20×10 ,, | | 27/6 |
| ,, | 18¾×14 ,, | | 19/6 |
| C.W. | 20×14 ,, | | 16/- |
| ,, | 28×20 ,, | | 34/- |
| ,, | 20×10 ,, | | 22/7½ |
| ,, | 18¾×14 ,, | | 16/- |
| Terneplates | 28×20 | | 33/6 per box basis f.o.b. |

## SWEDISH CHARCOAL IRON & STEEL.

| | | | |
|---|---|---|---|
| Pig-iron | £6 0 0 | to | £7 10 0 |
| Bars, hammered, basis | £17 10 0 | to | £18 10 0 |
| Bars and nail-rods, rolled, basis | £15 15 0 | to | £16 15 0 |
| Blooms | £10 0 0 | to | £12 0 0 |
| Keg steel | £32 0 0 | to | £33 0 0 |
| Faggot steel | £20 0 0 | to | £24 0 0 |
| Bars and rods dead soft, steel | £11 0 0 | to | £14 0 0 |

All per English ton, f.o.b. Gothenburg.

### TUBES AND FITTINGS.

Over ¼ in. up to 6 in.

| | *Tubes.* | *Fittings.* |
|---|---|---|
| Gas | 65% | 47½% |
| Water | 61½% | 42½% |
| Steam | 57½% | 37½% |

W.I. 10% extra.

### DAILY FLUCTUATIONS.

**Standard Copper** (cash).

| | | £ | s. | d. | | |
|---|---|---|---|---|---|---|
| Dec. | 5 .. | 68 | 15 | 0 | dec. | 2/6 |
| ,, | 6 .. | 68 | 5 | 0 | ,, | 10/– |
| ,, | 9 .. | 68 | 12 | 6 | inc. | 7/6 |
| ,, | 10 .. | 68 | 15 | 6 | ,, | 2/6 |
| ,, | 11 .. | 68 | 12 | 6 | dec. | 3/– |

**Electrolytic Copper.**

| | | £ | s. | d. | | |
|---|---|---|---|---|---|---|
| Dec. | 5 .. | 83 | 0 | 0 | No change | |
| ,, | 6 .. | 83 | 0 | 0 | ,, ,, | |
| ,, | 9 .. | 82 | 0 | 0 | dec. | 20/– |
| ,, | 10 .. | 82 | 0 | 0 | No change | |
| ,, | 11 .. | 82 | 0 | 0 | ,, ,, | |

**Standard Tin** (cash).

| | | £ | s. | d. | | |
|---|---|---|---|---|---|---|
| Dec. | 5 .. | 174 | 0 | 0 | dec. | 50/– |
| ,, | 6 .. | 173 | 5 | 0 | ,, | 15/– |
| ,, | 9 .. | 177 | 10 | 0 | inc. | 85/– |
| ,, | 10 .. | 181 | 0 | 0 | ,, | 70/– |
| ,, | 11 .. | 179 | 15 | 0 | dec. | 25/– |

**Tin** (English ingots).

| | | £ | s. | d. | | |
|---|---|---|---|---|---|---|
| Dec. | 5 .. | 175 | 5 | 0 | dec. | 65/– |
| ,, | 6 .. | 174 | 15 | 0 | ,, | 10/– |
| ,, | 9 .. | 178 | 15 | 0 | inc. | 80/– |
| ,, | 10 .. | 182 | 0 | 0 | ,, | 65/– |
| ,, | 11 .. | 181 | 5 | 0 | dec. | 15/– |

**Zinc Sheets** (English).

| | | £ | s. | d. | | |
|---|---|---|---|---|---|---|
| Dec. | 5 .. | 30 | 0 | 0 | inc. | 10/– |
| ,, | 6 .. | 30 | 0 | 0 | No change | |
| ,, | 9 .. | 30 | 0 | 0 | ,, ,, | |
| ,, | 10 .. | 30 | 0 | 0 | ,, ,, | |
| ,, | 11 .. | 30 | 0 | 0 | ,, ,, | |

**Spelter** (ordinary).

| | | £ | s. | d. | | |
|---|---|---|---|---|---|---|
| Dec. | 5 .. | 20 | 7 | 6 | inc. | 3/9 |
| ,, | 6 .. | 20 | 2 | 6 | dec. | 5/– |
| ,, | 9 .. | 20 | 6 | 3 | inc. | 3/9 |
| ,, | 10 .. | 20 | 3 | 9 | dec. | 2/6 |
| ,, | 11 .. | 20 | 2 | 6 | ,, | 1/3 |

**Lead** (English).

| | | £ | s. | d. | | |
|---|---|---|---|---|---|---|
| Dec. | 5 .. | 22 | 15 | 0 | No change | |
| ,, | 6 .. | 22 | 15 | 0 | ,, ,, | |
| ,, | 9 .. | 22 | 15 | 0 | ,, ,, | |
| ,, | 10 .. | 22 | 10 | 0 | ,, ,, | |
| ,, | 11 .. | 22 | 15 | 0 | ,, ,, | |

## AVERAGE MONTHLY PRICES OF DERBYSHIRE NO. 3 FOUNDRY AT MANCHESTER.

| Year | Jan. | Feb. | March | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Yearly average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. |
| 1895 .. .. | 2 3 0 | 2 3 0 | 2 2 6 | 2 2 6 | 2 2 6 | 2 4 0 | 2 3 6 | 2 4 0 | 2 5 0 | 2 5 6 | 2 6 6 | 2 5 6 | 2 3 11½ |
| 1896 .. .. | 2 5 6 | 2 6 0 | 2 6 0 | 2 6 0 | 2 6 0 | 2 5 6 | 2 5 0 | 2 5 0 | 2 5 0 | 2 6 0 | 2 7 0 | 2 8 6 | 2 5 11½ |
| 1897 .. .. | 2 10 0 | 2 11 0 | 2 9 0 | 2 8 6 | 2 8 0 | 2 7 0 | 2 7 0 | 2 7 0 | 2 6 0 | 2 6 0 | 2 6 6 | 2 7 6 | 2 7 9½ |
| 1898 .. .. | 2 7 6 | 2 8 0 | 2 8 0 | 2 8 6 | 2 8 6 | 2 10 0 | 2 10 0 | 2 10 0 | 2 10 0 | 2 11 0 | 2 14 0 | 2 14 0 | 2 9 11 |
| 1899 .. .. | 2 13 0 | 2 14 0 | 2 14 0 | 2 14 0 | 3 0 0 | 3 2 0 | 3 13 0 | 3 16 6 | 3 15 0 | 3 16 6 | 3 16 6 | 4 0 0 | 3 6 2½ |
| 1900 .. .. | 4 0 0 | 4 0 0 | 4 0 0 | 4 1 6 | 4 1 0 | 3 18 0 | 3 13 6 | 3 12 6 | 3 11 0 | 3 11 0 | 3 9 6 | 3 8 0 | 3 15 5 |
| 1901 .. .. | 2 13 6 | 2 17 0 | 2 15 0 | 2 15 0 | 2 14 0 | 2 13 9 | 2 13 6 | 2 13 6 | 2 14 6 | 2 13 0 | 2 12 6 | 2 16 6 | 2 14 3½ |
| 1902 .. .. | 2 17 6 | 2 17 6 | 2 15 6 | 2 16 9 | 2 16 6 | 2 16 6 | 2 16 6 | 2 17 0 | 2 18 6 | 2 18 6 | 2 17 6 | 2 17 6 | 2 17 1½ |
| 1903 .. .. | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 |
| 1904 .. .. | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 |
| 1905 .. .. | 2 13 0 | 2 13 0 | 2 11 6 | 2 12 6 | 2 12 0 | 2 12 0 | 2 12 3 | 2 12 3 | 2 14 0 | 2 16 6 | 3 0 0 | 3 0 6 | 2 14 1 |
| 1906 .. .. | 3 2 0 | 3 5 0 | 3 3 0 | 3 0 6 | 2 17 0 | 2 18 6 | 2 18 0 | 2 16 6 | 2 19 0 | 3 0 6 | 3 1 6 | 3 7 0 | 3 0 8½ |
| 1907 .. .. | 3 7 0 | 3 7 0 | 3 5 0 | 3 2 0 | 3 4 0 | 3 8 0 | 3 6 0 | 3 5 0 | 3 4 0 | 3 2 6 | 3 1 0 | 2 18 6 | 3 4 2 |
| 1908 .. .. | 2 15 0 | 2 14 6 | 2 14 6 | 2 15 6 | 2 16 0 | 2 13 0 | 2 13 0 | 2 11 6 | 2 12 6 | 2 13 0 | 2 12 6 | 2 12 6 | 2 13 5½ |
| 1909 .. .. | 2 13 0 | 2 12 6 | 2 11 6 | 2 12 0 | 2 12 6 | 2 12 6 | 2 12 0 | 2 12 6 | 2 14 6 | 2 15 0 | 2 14 6 | 2 14 0 | 2 13 0½ |
| 1910 .. .. | 2 13 9 | 2 14 0 | 2 14 0 | 2 14 4 | 2 15 0 | 2 15 0 | 2 14 9 | 2 15 0 | 2 15 0 | 2 15 0 | 2 15 0 | 2 15 0 | 2 14 7½ |
| 1911 .. .. | 2 16 0 | 2 16 0 | 2 16 0 | 2 16 0 | 2 16 0 | 2 16 0 | 2 16 0 | 2 16 0 | 2 16 0 | 2 14 6 | 2 15 0 | 2 15 0 | 2 15 8½ |
| 1912 .. .. | 2 17 4½ | 2 17 6 | 2 17 6 | 3 1 1½ | 3 2 6 | 3 3 9 | 3 6 3 | 3 7 6 | 3 10 10½ | 3 12 6 | 3 13 3½ | 3 14 6 | 3 5 4 |
| 1913 .. .. | 3 15 7 | 3 15 0 | 3 11 10½ | 3 11 4½ | 3 10 2½ | 3 6 10½ | 3 4 2½ | 3 2 9 | 3 1 9 | 3 1 0 | 2 19 3 | 2 17 2½ | 3 6 5 |
| 1914 .. .. | 2 17 2½ | 2 18 0 | 2 18 0 | 2 17 0 | 2 17 0 | 2 16 7½ | 2 16 0 | 3 2 10 | 3 1 0 | 2 19 9½ | 2 16 11½ | 2 18 1½ | 2 18 2 |
| 1915 .. .. | 3 1 2 | 3 3 11 | 3 5 9 | 3 18 8½ | 3 13 7 | 3 14 1 | 3 15 0 | 3 13 3 | 3 12 0½ | 3 11 1 | 3 14 0 | 4 3 3 | 3 12 2½ |
| 1916 .. .. | 4 4 6½ | 4 11 6 | 4 11 6½ | 4 7 6 | 4 7 6 | 4 7 6 | 4 10 0 | 4 12 10 | 4 12 6 | 4 12 6 | 4 12 6 | 4 12 6 | 4 8 6½ |
| 1917 .. .. | 4 12 6 | 4 12 6 | 4 12 6 | 4 12 6 | 4 12 6 | 4 12 6 | 4 12 6 | 4 12 6 | 4 12 6 | 4 12 6 | 4 12 6 | 4 12 6 | 4 12 6 |
| 1918 .. .. | 4 12 6 | 4 12 6 | 4 12 6 | 4 12 6 | 4 12 6 | 4 12 6 | 4 12 6 | 4 12 6 | 4 12 6 | 4 12 6 | 4 12 6 | 4 12 6 | 4 12 6 |
| 1919 .. .. | 4 12 6 | 4 12 6 | 4 12 6 | 4 12 6 | 7 2 6 | 7 5 0 | 8 8 5 | 9 0 0 | 9 0 0 | 9 0 0 | 9 0 0 | 9 0 0 | 7 3 10 |
| 1920 .. .. | 9 13 9 | 10 0 0 | 10 5 3 | 10 15 3 | 11 10 0 | 12 2 6 | 12 5 0 | 13 1 3 | 14 7 6 | 14 5 0 | 14 5 0 | 14 5 0 | 12 12 1½ |
| 1921 .. .. | 12 11 8 | 10 8 9 | 9 2 6 | 8 2 0 | 8 0 0 | 8 0 0 | 8 0 0 | 8 1 8 | 7 4 0 | 6 7 6 | 5 7 6 | 4 16 10 | 8 0 2 |
| 1922 .. .. | 5 5 0 | 4 17 6 | 4 15 0 | 4 15 0 | 4 12 6 | 4 12 6 | 4 12 6 | 4 12 6 | 4 11 3 | 4 10 0 | 4 10 0 | 4 10 0 | 4 13 7½ |
| 1923 .. .. | 4 12 8½ | 5 0 2 | 6 2 6 | 6 8 7½ | 6 2 5 | 5 11 9 | 5 9 1½ | 5 4 0 | 5 0 0 | 5 0 9 | 5 0 7 | 5 2 9 | 5 7 11½ |
| 1924 .. .. | 5 3 0 | 5 3 0 | 5 3 0 | 5 3 0 | 5 2 10 | 5 1 3 | 4 17 11 | 4 15 6 | 4 13 6 | 4 10 1½ | 4 10 0 | 4 10 3 | 4 17 9½ |
| 1925 .. .. | 4 10 0 | 4 9 0 | 4 6 9 | 4 5 2½ | 4 3 0 | 4 0 1½ | 4 17 1½ | 3 15 7½ | 3 14 3½ | 3 13 4½ | 3 13 4½ | 3 13 2½ | 4 1 9 |
| 1926 .. .. | 3 14 9 | 3 15 3 | 3 15 6 | 3 15 3½ | 3 17 6 | 4 5 9 | 4 16 9 | * | * | * | * | 4 12 6 | 4 0 1½ |
| 1927 .. .. | 4 13 9½ | 4 13 3 | 4 11 1½ | 4 9 4½ | 4 6 1½ | 3 19 1½ | 3 16 1½ | 3 15 6 | 3 13 4½ | 3 13 4½ | 3 14 0 | 3 13 6½ | 4 1 6½ |
| 1928 .. .. | 3 13 2½ | 3 12 3½ | 3 12 3 | 3 11 6 | 3 11 6 | 3 10 0 | 3 8 3 | 3 7 8½ | 3 7 6 | 3 7 9½ | 3 8 3 | 3 7 6 | 3 9 10½ |
| 1929 .. .. | 3 8 3½ | 3 10 4½ | 3 10 10½ | 3 11 0 | 3 11 2½ | 3 12 0 | 3 12 4½ | 3 14 6 | 3 15 1½ | 3 17 0 | 3 17 0 | — | — |

* No prices available during strike period.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